AMERICAN
DYESTUFF REPORTER

VOLUME 34 SEPTEMBER 10, 1945 NUMBER 19

pH CONTROL IN DYEING PROCESSES

EDGAR I. NOBLE, M. Sc.

(Sandoz Ltd., Melbourne, Australia)

THE control of acidity and alkalinity in the preparation and dyeing of textiles and leather is a matter of fundamental importance. This applies particularly to the wet processing of wool, silk and leather, being animal proteins which combine with acids or alkalis, and especially to their dyeing. Success or failure may depend upon very small changes in acidity or alkalinity.

THE MEANING OF pH (1)

The acidic properties of an acid in water are attributed to hydrogen ions, which are hydrogen atoms with positive charges, called protons. The degree of the formation of hydrogen ions (or hydrions) varies with different acids or other substances, and hence to measure the effective acidity it is necessary to determine the hydrogen ion concentration or the hydrogen ion activity, as it is better expressed.

Water ionizes by self-impact, when water molecules combine with one another, thus:—

$2H_2O \rightleftarrows H_3O^+ + OH^-$ and dissociate into a hydrogen ion H_3O^+ and a hydroxyl ion OH^- (2). For convenience, however, the conventional sign of H^+ is retained, to express the hydrogen ion.

Since one molecule in every 555 million of pure water ionizes or splits up into one hydrogen and one hydroxyl ion, $H_2O = H^+ + OH^-$, there is in pure water a hydrogen ion concentration of $\frac{1}{10{,}000{,}000}$ of a gram ion per liter, at 25 deg. C. This small number may be expressed as $\frac{1}{10^7}$ or 10^{-7} or pH 7.

Thus a pH value represents minus the logarithm (to the base ten) of the hydrogen ion concentration in gram ions per liter.

In pure water since hydrogen and hydroxyl ions are produced in equal numbers, the product of the concentration of these two ions at 25 deg. C will be $10^{-7} \times 10^{-7} = 10^{-14}$. It can be shown that the product of these two concentrations remains approximately constant when acids and alkalis and other substances are dissolved in water. The addition of caustic soda (NaOH) to a solution raises the hydroxyl ion concentration, and the hydrogen ion concentration must fall by a corresponding factor. In a tenth normal solution of caustic soda, the hydrogen ion concentration is 10^{-13} gram ions per liter and the pH is 13.

It should be noted that there are ten times more hydrogen ions in a solution at pH 3 than in one at pH 4 and a thousand times more than a solution at pH 6. A solution at pH 3.22 contains double the hydrogen ions in a solution at pH 3.52, the numbers being 3×10^{-4} and and 6×10^{-4}.

THE MEASUREMENT OF pH

Two types of methods are used, namely colorimetric and electrometric. In the former, use is made of indicators, which change in shade over a range of 1 to 2 units of pH. Methyl orange, for example, changes from its pink color at pH 3.1 to its yellow color at pH 4.4, and the shades in between can be judged to within 0.2 pH units. "Universal indicator" is a mixture of indicators for rough examinations. Spotting indicators on to wool and silk gives no reliable indication of the pH of the fiber.

For testing the pH of colored solutions, such as dyebaths, the "Lyphan" test papers are most useful. This consists of a strip of paper impregnated with a band of indicator and several comparison colors representing differences of 0.2 pH units. On dipping the test paper into the colored solution, the indicator and the standard are both colored to the same extent.

For electrical determinations of pH values, the glass electrode instrument is now being used in textile factories.

In the near future, continuous recording pH meters will operate electro-magnetic devices to control the addition of soda to wool-scouring machines or to neutralize carbonized wools, so that a constant pH is maintained in such processes. According to Dr. M. Dole (2), maximum brightness in scouring wool is obtained at pH 10.7, and higher or lower figures showed a marked falling off. pH control in alkaline scouring is an important factor in preserving the strength of the wool and in achieving subsequent consistent dyeing results.

In measuring the pH of alkaline scouring liquors, errors may arise in using colorimetric methods. The ordinary glass electrode is also subject to errors at high pH values, but glass electrodes made from Beckman glass show an error of only one-tenth of a pH unit at pH 11.4 (2).

pH values vary with temperatures. For example a 0.5 p.c. soap solution showed at 25 deg. C. pH 10.4, 40 deg. C. pH 10, 60 deg. C. pH 9.48, and at 80 deg. C. pH 9.24. On boiling scoured wools in distilled water and testing the pH of the water, the results usually vary from about pH 7 to 9.

Now let us examine the changes in pH occurring when an alkali, ammonia, is added to solutions of various acids used in dyeing processes.

pH CONTROL BY "BUFFER" SOLUTIONS

Acetic, formic, phosphoric and sulfuric acids were made up into solutions of equivalent strength (0.033 Normal); 50 ccs. of each acid were taken and a normal solution of ammonia added from a burette.

The pH of each solution rose gradually. It was observed that a small addition of ammonia causes a steep rise in the pH of the sulfuric acid and ammonium sulfate mixture at pH 3 to pH 8 when all the sulfuric acid has been neutralized by the ammonia to form ammonium sulfate at pH 7. The addition of the same amount of ammonia to the formic acid showed a rise from pH 5 to pH 8.5, and with acetic acid from pH 5.5 to 8. By contrast, with phosphoric acid (H_3PO_4) a large amount of ammonia is needed to cause an increase from pH 5 to 8. Thus mixtures of phosphoric acid and ammonia between pH 5 and pH 8 resist change in pH when an acid, alkali or water is added. Such mixtures are known as "buffer" solutions. In this case the maximum buffer action, that is, resistance to change in pH, is between pH 6 and 7.

The curve at pH 4.6 showed the formation of the acid salt called ammonium dihydrogen phosphate, known commercially as mon-ammonium phosphate. By adding mon-ammonium phosphate or this mixture of ammonia and phosphoric acid to an alkali, therefore, the resultant pH of the solution may be controlled to definite limits.

Advantage is taken of the buffering action of phosphates, pyro-phosphates, acetates, formates, carbonates and borates to control the pH in many chemical processes. This technique could be applied more widely in the preparation and dyeing of textiles.

WOOL SCOURING

It has been previously stated that scouring liquors should not be too alkaline, otherwise the wool is impaired. Maximum brightness is at pH 10.7 (2), using soap and alkali, but wool may be scoured at lower pH values by using modern detergents.

Wool, extracted with petrol to leave a grease content of 0.39 per cent, dyes much slower than soap and soda scoured wool (grease content 0.38 per cent). If it is assumed that solvent extraction of wool causes little or no alteration in the wool fiber itself, the faster rate of dyeing of the soap, soda, scoured wool is due to some change in the wool closely related to "alkali damage" (15). The faster dyeing rate may be also due to the greater accessibility of the fiber, caused by fiber swelling at the high pH value of the soap and soda scour.

WOOL BLEACHING

Hydrogen peroxide bleaching baths (2 volumes) are often made alkaline with ammonia or sodium silicate, and the treatment carried out for several hours at a low temperature. Hydrogen peroxide bleaching is also recommended as a pre-

Keep ON Buying and Holding Bonds!

treatment for reducing the affinity of wool for dyes, although the initial dyeing rate is faster. Damaged wool reacts quicker with hydrogen peoxide than normal wool, to produce subsequently more even dyeings. The treatment is carried out at pH 9.5 and the pH is controlled by adding 3 lb. trisodium phosphate per 100 gallons of liquor (3). This method of control could be used instead of using ammonia or sodium silicate in peroxide bleaching. The effect of hydrogen peroxide bleaching at increasing pH values has been investigated by Smith and Harris (14).

Sulfur stoving will acidify alkaline wool, according to the titration curve of sulfurous acid, which is very similar to that of phosphoric acid from pH 10 to pH 2.

The alternate method of bleaching with a buffered hydrosulfite of the Arostit BI type, instead of sulfur stoving, produces an almost identical result, in the excellence of the bleach, with the advantage of greater stability to washing. Sodium pyrophosphate is usually the buffer used in the hydrosulfite, to control the pH of the bleaching bath.

THE THEORY OF WOOL DYEING AND pH CONTROL

Wool is dyed from baths varying from about pH 1 to pH 10, according to the chemicals and dyes used. The degree of perfection obtained in the dyeing process depends largely upon the control of the pH of the dyebath and on the uniformity of the pH of the wool. Wool suffers damage by boiling in very strong acids or alkalis, and such conditions are to be avoided.

According to present chemical theories of wool dyeing, it is considered that the addition of an acid to wool, either before or during dyeing, fulfils two functions. Firstly, any residual alkali is neutralized, and secondly, with larger amounts of acid, the wool combines with the acid according to the hydrogen ion concentration of the external solutions. The addition, to this system, of a dyestuff, which may undergo double decomposition during dyeing, may necessitate the addition of more acid to the dyebath to keep the pH low enough to complete the dyeing (4, 5, 6).

This theory may also be expressed in another fashion. When a neutral wool fiber is placed in a dyebath containing acid, the hydrogen ions present in the solution diffuse into the fiber and combine with the ionized carboxyl groups of the wool, giving it a positive charge, which attracts anions (e. g., sulfate, phosphate, dye ions), and causes these also to diffuse into the fiber approaching as closely as possible to the positively charged amino groups. The more mobile ions, e.g., sulfate ions, diffuse into the fiber first and are followed at a later period by the larger and less mobile dye anions (7, 8).

When both ions are present there is competition between them for the available quarternary ammonium groups, as is also the case when chromate or sulfate ions are present. The final amount of these anions absorbed by the fiber depends upon the proportion of the various ions present, together with their relative chemical affinity for the basic groups (7).

In short, the attraction of wool for the dye is determined mainly by the hydrogen ion concentration, the pH, of the dyebath. Dyeing rates and total amount of color dyed may be altered by previous treatments, such as carbonizing chlorination, pH being involved (15). Dyeing is influenced by fiber swelling, which is smallest at the iso-electric point of wool, pH 4.8. Besides pH, temperature, time, liquor circulation, volume are factors of importance.

Two very important questions asked by the wool dyer are these:—If a certain pH value of a dyebath is the most suitable to dye a particular acid or chrome color on scoured wool, say at pH 6, does it make any difference how this degree of acidity is attained, whether it be with either acetic, formic, phosphoric or sulfuric acids, or ammonium sulfate or ammonium di-hydrogen phosphate by neutralization of the residual alkali? Does the wool tend to dye unevenly by any of the acidifying methods, particularly if the wool is unequally treated?

TABLE I
pH Changes in Dyeing Wool by Different Methods

Percentage Amount on First Hank	Plus 2nd Hank	Acid Salt or Acid	Bath Only 1:15	pH Readings: Bath with 1st Hank — After 30 secs. at 22 deg. C.	After 24 hrs. at 22 deg. C.	Plus 2nd Hank After 2 hours at 90 deg. C.	Dyed with ¾% Brill. Aliz. Sky Blue BS 222% 1 hr. at 80 deg. C.	After dyeing further hour at 90 deg. C.	Percentage Exhaustion
									%
3	1.5	Ammonium sulfate (Pure)	6.8	7.6	7.4	7.4	7.2	6.3	99
3	1.5	Ammonium sulfate (Commercial)	6.8	7.6	7.4	7.5	6.8	6.2	99
10	5	Ditto	6.5	7.3	7.1	6.8	6.3	6.0	100
5	2.5	Mon-Ammonium Phosphate (Amm. Dihydrogen Phosphate)	5.5	6.0	6.3	6.5	6.5	6.3	100
20	10	Ditto	5.1	5.5	5.6	5.9	6.0	5.8	100
2	1	Acetic Acid 60%	3.6	4.4	4.9	5.9	7.2	6.5	98
0.5	0.25	Formic Acid 90%	3.3	4.0	5.7	7.0	7.6	7.4	95
1.4	0.7	Phosphoric Acid 90%	2.7	3.0	5.0	6.4	6.8	6.7	97
0.6	0.3	Sulfuric Acid 98%	2.7	3.0	5.6	7.0	7.2	7.1	97
3	1.5	Sodium Bichromate	5.0	5.8	6.5	7.7	7.9	7.6	..
		Second Series of Tests				*Second Series of Tests*			
5	2.5	Puron (Sod. Dihydrogen Pyro-Phosphate)	4.7	5.4	6.3	Dye added 30 secs. after 2nd Hank	6.8	..	97
20	10	Ditto	4.2	4.8	5.5	"	5.9	..	100
1	0.5	Resoline NC conc. (Alkyl Naphthalene Sulfonic Acid)	3.4	6.1	8.2	"	8.0	..	75
10	5	Ditto	2.3	2.5	4.6	"	7.0	..	97
4	2	Acetic Acid 60%	3.5	4.0	4.4	"	5.2	Additions Before	100
1	0.5	Formic Acid 90%	3.2	3.5	4.1	"	6.3	Dyeing	100
2.5	1.25	Phosphoric Acid 90%	2.5	2.7	3.3	"	5.9	20% Glauber	100
1.2	0.6	Sulfuric Acid 98%	2.5	2.5	3.3	"	6.2	Salt Crystals added	100

Melbourne tap water pH 7.5.
Wool bodied in distilled water 1:30 pH 7.9.
Brilliant Alizarine Sky Blue BS Pat. 222% 1:400 water pH 9.6.

To provide an answer to these questions, the effect of adding hanks of scoured worsted yarn to various acid solutions are shown in Table I.

COMMENTS ON THE TESTS DESCRIBED IN TABLE I

pH readings were taken of the solutions with a Coleman glass electrode pH meter before adding half the wool (one hank) and after immersion for 30 secs., 20 minutes, 35 minutes, and 24 hours cold. Then another hank of wool of equal weight was added, and pH readings taken after two hours at 90 deg. C. and 24 hours cold. In this manner the two hanks received unequal treatments in the acids and salts used. When the dye, 0.25 per cent. Brilliant Alizarine Sky Blue BS 222 per cent pat., was added, there was a tendency at first for the first hank to dye slightly deeper than the second hank where acetic, formic, phosphoric and sulfuric acids were used, but, on boiling, all the hanks were the same depth of shade and evenly dyed. The final pH of the dyebaths varied from pH 5.8 to 7.4.

Similar tests were repeated, using Brilliant Alizarine Milling Blue BL patented, an acid color not so level dyeing as the former. The hanks steeped in ammonium sulfate or ammonium dihydrogen phosphate again dyed evenly throughout, but with acetic, formic, phosphoric or sulfuric the dyeings were not level.

In these laboratory tests excellent circulation of the acids throughout the wool could be obtained, so that although the two hanks received unequal acid treatments at the start, equilibrium was sufficiently attained to enable both hanks to dye almost equally by any of the acids or acidifying salts used.

Practical dyeing results also confirm that alkaline wools may be acidified with small equivalents of either acetic, formic, phosphoric or sulfuric acids, and dyed evenly, at least according to top or loose wool dyeing stadnards, *provided the acid is EVENLY distributed throughout the wool before dyeing* and provided *the EXACT amount of acid is taken* so that the pH of the dyebath is suitable for the dyestuffs used. These stipulations are difficult to ensure in bulk dyeings. Consider the following illustration:—

Supposing 0.5 per cent sulfuric acid is added to 250 lb. of loose wool in a dyeing machine—consider the wool as packed in five layers of 50 lb. each, one on top of the other. Let us assume that the wool contains an alkalinity equal to 0.53 per cent sodium carbonate above pH 7. Then if the acid is circulated throughout the wool evenly, all the soda ash would be neutralized, the acid being converted into Glauber's salt and the liquor would be at pH 7. But this does not happen in practice, because the 0.5 per cent sulfuric acid is equivalent to 2.5 per cent on the bottom 50 lb. layer of wool as the acid is pumped up, and it not only neutralizes the alkalinity, but acidifies it to about pH 3, leaving the top layer still at about pH 8. It follows that repeated circulation of the acid must take place before there is any hope of producing the same pH throughout the wool. If meanwhile dye is added, the dyeing will be uneven, unless the dyes have such good levelling properties that boiling will cause the dye to redistribute itself, when eventually the wool attains the same pH throughout.

Furthermore, if in our illustration the alkalinity is doubled, i.e., expressed as soda ash, 1.06 per cent on the weight of wool, then dyeing will proceed from an alkaline bath at above pH 9, with resultant poor exhaustion and damage to the wool. On the other hand, if the acid is increased by carelessness from 0.5 per cent to 1 per cent sulfuric acid, the bath is about pH 4, which would cause dyeing to be far too rapid for many acid milling and chrome colors. These remarks also apply to the use of acetic and formic acid, but to a smaller extent.

In the example given, the amount of phosphoric acid, 90 per cent, needed to neutralize the 0.53 per cent soda ash to pH 7, may be calculated as 0.73 per cent, and because a buffer mixture is formed, small increases in the alkalinity or the phosphoric acid will not seriously alter the resultant pH value. These small quantities, ½-1½ per cent of phosphoric acid 90 per cent will give very good results in dyeing loose wool or tops from dyebaths at pH 5 to 7, provided the diluted acid is circulated well before adding the dye. The method affords some means of controlling the pH of the dyebath, which is not achieved by acetic, formic, or sulfuric

acid, in this pH range.

From the chemical formulae it is colculated that 0.53 per cent soda ash is neutralized on boiling to pH 7 by—

(a) 0.66% Ammonium Sulfate.
(b) 0.76% Mon-Ammonium Phosphate (Ammonium Dihydrogen Phophate).
(c) 1% Acetic Acid 60%.
(d) 0.5% Formic Acid 90%.
(e) 0.73% Phophoric Acid 90%.
(f) 0.5% Sulfuric Acid 98%.

pH CONTROLLED METHODS OF DYEING WOOL

By using excess, i.e., larger amounts than those required for neutralization, say 5 per cent ammonium sulfate or 5 per cent mon-ammonium phosphate, we can ensure that all the alkalinity in the wool is neutralized, even if the amount of alkali is much more than expected, *without any appreciable lowering of the pH of the bath* and *the wool acquires the same pH throughout*. Here we have two methods of controlling the pH of wool dyebaths between pH 5.5 to 8, which are foolproof. The changes in pH of the ammonium sulfate or the mon-ammonium phosphate baths, before and after adding the wool, before and after adding the dye, and at the end of the dyeing process, do not show large variations as is seen from Table I, whereas by the use of strong acids large changes in pH occur. This is what is meant by pH control.

By the same line of reasoning it is evident that if dyebaths of stronger acidity are required, say at pH 5.5 to 4, then the addition of 1½ per cent to 6 per cent acetic acid 60 per cent, varying in pH from 3.7 to 3.2, provides an acid bath nearest in pH to that required for dyeing. The maximum buffering effect of acetic is at pH 4.7, near the iso-electric point of wool. A large number of chrome and acid milling dyestuffs are dyed on wool with good exhaustion in dyebaths at pH 4.3 to pH 4.9. Formic acid gives good buffering between pH 5 to 3.5, and so it may be used instead of acetic acid.

Similarly, other acids have their most suitable pH ranges of dyeing.

It should be realized that in dyebaths above pH 5.5 that any acetic, formic, or sulfuric acid added, will not be present as acids, but as almost neutral acetate, formate or sulfate. The acids will have been practically neutralized, but in the case of phosporic acid, this has been converted to sodium (or ammonium) dihydrogen phospate, an ACID salt.

Citric acid has an almost straight pH titration (neutralization) curve, and dyebaths at suitable and definite pH values may be made by buffered mixtures of citric acid and ammonia (11). Citric acid, however, is scarce and expensive.

TABLE II
pH Controlled Methods of Dyeing Wools with Acid and Chrome Colors For Wool Scoured or Neutralized to pH 7 to 9

Method			*pH Chemicals Only*	*pH of Exhausted Dyebath*
I		20-10% Glauber's Crystals 3-8% Phosphoric Acid 90%	2.6-2	4.4-2.5
II		20-10% Glauber's Crystals 1-3% Formic Acid 90%	3.3-2.8	5-3.5
III		20-10% Glauber's Crystals 2-6% Acetic Acid 60%	3.7-3.3	5.5-4
IV (a)		5% Mon-Ammonium Phosphate	5.5-4.5	7-5.5
		or		
(b)		0.5-1.5% Phosphoric Acid 90%	2.9-2.6	7-5.5
	and	5% Ammonium Sulfate Recommended for loose wool and tops		
V (a)		3-10% Ammonium Sulfate	6.8-6.5	8-6 (by boiling)
		or		
(b)		3% Phosphoric Acid 90% Neutralized with Ammonia to pH 6.5	6.5	8-6 (by boiling)

Notes.—In method IV (a) instead of using 5 per cent. Mon-ammonium phosphate, 3 per cent phosphoric acid 90 per cent may be diluted and neutralized with ammonia to pH 4.4. If calcined Glauber's salt is used the amounts should be 8-4 per cent, decreasing quantities with increasing amounts of dye.

For afterchrome colors the requisite amount of bichrome is added when the color has exhausted sufficiently and boiling continued until the shade has sufficiently developed.

For metachrome colors the metachrome mordant is used with Methods V (a) or V (b).

A mixture of equimolecular proportions of acetic and phosphoric acid also gives a very straight pH titration curve with ammonia, but this is of theoretical interest only.

Sodium dihydrogen pyro-phosphate (Puron) was used in the tests in Table I as an acidifying agent, but it cannot be recommended, as it would be precipitated in hard water, as calcium dihydrogen pyro-phosphate.

PRACTICAL DYEING

The wool dyers' ideals may be closely met by the use of the pH controlled methods recommended in Table II.

DETAILS OF THE DYEING METHODS IN TABLE II

Details are given to explain how and where these dyeing methods are used.

Method 1. Phosphoric Acid 90 per cent, is now available in a pure foodstuff quality, free from impurities of iron and calcium. The advantages of phosphoric acid in wool dyeing, compared with other acids, have already been described in a previous paper (12).

Briefly phosphoric acid has far less destructive action on stainless steel dyeing machines than acetic, formic, or sulfuric acids. If used for dyeing chrome colors the phosphates created prevent the dulling or drastic alteration in shade due to the presence of iron.

3 to 8 per cent phosphoric acid 90 per cent, according to the weight of dyestuff, are used to dye wool, tops, yarn or pieces with acid and chrome dyestuffs, normally dyed with sulfuric acid, e.g., Xylene Light Yellow 2G, Azo Rubinoles 2G and 3GS, Alizarine Light Blues FPSN supra, RGN, etc.; Acid Alizarine Black R, Omega Chrome Blues FB and F4B conc. Phosphoric acid may also be used for the dyeing of metallized dyes, e.g., Neolan or Vitrolan colors.

Method IV (b).—In dyeing wools scoured or neutralized to about pH 8 or 9, the addition of small amounts of phosphoric acid produce at pH 7 equal parts of sodium (or ammonium) dihydrogen phosphate and disodium (or diammonium) hydrogen phosphate. With small further additions of phosphoric acid the pH gradually drops to pH 4.4, the point at which the phosphoric acid is all coverted into the dihydrogen phosphate. Between the pH range of 8 and 4.4 nearly all the acid milling and afterchrome colors give good exhaustion. The amount of phosphoric acid added should be sufficient to neutralize the residual alkali. The pH of the bath will be controlled by the amount of phosphoric acid added; 5 per cent ammonium sulfate is also added to the dyebath to give additional pH control, advisable when deep shades are dyed. This method is extensively employed by several firms for the dyeings of loose wool and tops, where previously it was the custom to neutralize the alkaline tops with 2 per cent acetic acid 60 per cent, and then dye the acid, afterchrome or metachrome colors with 5 per cent ammonium sulfate.

It will be observed that phosphoric acid in Method IV (b) behaves as a weakly acid salt, but in Method I, as a strong acid, similar to sulfuric acid.

The manufacturers of phosphoric acid estimate that about 100 tons will be used for the dyeing of wool in the next 12 months in Australia.

Dyeing methods using phosphoric acid or a soluble acid salt thereof, e.g., mon-ammonium phosphate, are the subject of a patent application by the author in Australia (No. 13243/44), and in the U.K. and other countries.

Methods II and III.—Acetic and formic acids have always been extensively used, in wool dyeing. Quantitatively formic acid 90 per cent is twice as strong as acetic

(Continued on Page 367)

Proceedings of the
American Association of Textile Chemists and Colorists

SEPTEMBER 10, 1945

Officers of the Association

WILLIAM D. APPEL, *President*
National Bureau of Standards, Washington, D. C.

HUGH CHRISTISON—HENRY F. HERRMANN, *Vice-Presidents*

WILLIAM R. MOORHOUSE, *Treasurer*
National Aniline Division, Allied Chemical & Dye Corp., Boston, Mass.

HAROLD C. CHAPIN, *Secretary*
Lowell Textile Institute, Lowell, Mass.

LOUIS A. OLNEY
President Emeritus and Chairman of the Research Committee
Lowell Textile Institute, Lowell, Mass.

COUNCILORS

Representing Sections

HOWARD V. KING; BEN VERITY (Rhode Island)
JAMES P. CONAWAY; GLEN S. HIERS; BOYCE C. BOND (Philadelphia)
KENNETH H. BARNARD; PATRICK J. KENNEDY; ROY G. BUCK; LEONARD S. LITTLE; THOMAS F. O'BRIEN (New York)
EDWARD S. CHAPIN; HARRY M. HARTNETT; CHARLES H. A. SCHMITT (N. New England)
HENRY B. DIXON; SAMUEL L. HAYES (Piedmont)
ROBERT W. PHILIP (South Eastern)
E. H. DOBBINS (South Central)
HERBERT W. TETZLAFF; ARTHUR T. BRAINERD (Midwest)

Past Presidents

ELVIN H. KILLHEFFER; P. J. WOOD; ROBERT E. ROSE; WILLIAM H. CADY; ALBAN EAVENSON; CARL Z. DRAVES; THOMAS R. SMITH

Standing Committees of the Council and their Chairmen

Executive Committee on Research
Leonard S. Little, Chairman

Publicity
Winn W. Chase, Chairman

Appropriations
William R. Moorehouse, Chairman

Membership and Local Sections
Hugh Christison, Chairman

Publications
Louis A. Olney, Chairman

Corporate Memberships
Henry F. Herrmann, Chairman

Local Sections and Their Officers

Northern New England Section

Delbert E. Ray, Chairman, Massachusetts Mohair Plush Co. Western Ave., Lowell Mass.
Azel W. Mack, Secretary, Hart Products Corp., 176 Federal St., Boston, Mass.
G. Clifford Emmons, Vice-Chairman; George O. Linberg, treasurer

Rhode Island Section

Harold B. Sturtevant, Chairman, 44 Brookside Dr., Cranston, R. I.
Robert W. Joerger, Secretary, Institute Lane, North Scituate, R. I.
George H. Wood, Jr., Vice-Chairman; Robert R. Farwell, Treasurer

New York Section

Emmett J. Driscoll, Chairman, Turner-Halsey Co. 40 Worth St., New York, N. Y.
Norman A. Johnson, Secretary, American Dyestuff Reporter One Madison Ave., New York 10, N. Y.
Dr. Herman E. Hager, Vice-Chairman; Paul J. Luck, Treasurer

Philadelphia Section

Arthur W. Etchells, Chairman, Hellwig Dyeing Corp., Delaware Ave. and Comly St., Philadelphia, Pa.
A. E. Raimo, Secretary, John Campbell & Co., S. E. Corner Broad and Spring Garden Sts., Philadelphia 23, Pa.
Curt R. Baeringer, Vice-Chairman; W. F. Fancourt, 3rd, Treasurer

Piedmont Section

Sidney M. Cone, Chairman, Proximity Manufacturing Co., Greensboro, N. C.
John B. Neely, Secretary, Burlington Mills, Yarn Dyeing Div., Burlington, N. C.
Leland G. Atkins, Vice-Chairman; Wyss L. Barker, Treasurer

South Central Section

Frank F. Myers, Chairman, Geigy Co., 700 Belvoir Ave., Chattanooga, Tenn.
W. K. Newman, Secretary, Peerless Woolen Mills, Rossville, Ga.
W. P. Clements, Vice-Chairman; G. R. Bellamy, Treasurer

Midwest Section

Al. J. Feit, Chairman, E. I. duPont de Nemours & Co., Inc. 7 S. Dearborn Street, Chicago, Ill.
George B. Chabot, Jr., Secretary, Calco Chemical Division, American Cyanamid Co., 146 W. Kinzie Street, Chicago, Ill.
George E. Osha, Vice-Chairman; Joseph H. Jones, Treasurer

South-Eastern Section

O. G. Edwards, Chairman, Avondale Mills, Sylacauga, Ala.
W. B. Griffin, Secretary, Kali Manufacturing Co., 939 Highland Terrace, N. E. Atlanta, Ga.
J. E. Smenner, Vice-Chairman; Laurie E. Whittelsey, Treasurer

STUDENT CHAPTERS

Lowell Textile Institute
North Carolina State College
Philadelphia Textile Institute
New Bedford Textile School

Members should notify the **Secretary** immediately of all address changes

Postwar Possibilities in FINISHING FABRICS*

H. C. BORGHETTY
General Dyestuff Corp.

OUR subject this evening has been well chosen by your Committee because the time is now ripe to pause and take note of future trends. As our armies march triumphantly towards certain and swift victory, the textile industry, because of its status as the second essential requirement of man, is in a realistic position compared to some of the other more luxurious and less matter-of-fact industries. Our industry has not promised nonsense equivalent to the ten-decker bus, the fuel-less automobile, or the flying roller skate. It can prepare itself for reconversion by merely changing the harnesses on the looms and by weighting-out different dyestuffs and chemicals. It is true that we have heard some optimistic reports about "tailor made" synthetics for any and all requirements. These are still in the test tube stage and will have to prove themselves worthy of a place alongside viscose, acetate and nylon, which have made their mark. Even though "King Cotton" trembles on his throne, he is far from tottering. You will recall in fact, some years ago how the "planners" predicted dyeing in the rayon mass to eliminate yarn and piece goods dyeing. This never did materialize, undoubtedly because flexibility to meet market requirements is more important where style prevails than standardization achieved at the cost of staggering inventories and a 10-12 weeks' lag in delivery.

To New England finishers goes credit for the substantial development of the spun rayon fabric which you were able to process on your machines and thus fill the void created by the move of the cotton industry Southwards.

I have here a spun rayon fabric, 80 per cent rayon-20 per cent wool, woven in Woonsocket ten years ago and finished along the banks of one of your pleasant streams. That is your own work—one of your great potentialities. This fabric has been outstanding in shrinkage control, non-crush properties and wearing comfort.

Some years ago the word finishing comprised all the operations given to a fabric after it left the loom. Finishing operations gave the sales appeal to fabrics. As better dyestuffs appeared and greatly enhanced sales appeal, dyeing and printing (printing is really localized or partial dyeing), became more important. The finishing operations proper were thus confined to starching, framing, calendering.

FINISHING PLANT

Bleaching / Dyeing / Printing / Finishing

These finishing procedures were empirical and yet so secretive that many years were required to break down the finishers' psychology and introduce chemical control. When this occurred, it was quickly apparent that bleaching, dyeing and printing could give only eye appeal to fabrics. Their application methods were expanded to give better color fastness, greater plant efficiency and continuity. Finishing operations, however, could now resume their importance by imparting new and desired properties, such as increased wearability, abrasion and tear resistance, stabilization of weaving, non-slip finish, shrinkage control, Sanforizing—crush resistance, flame resistance, water repellency, glazing or deluster, mildew repellency, variety of "band," acid fading (atmospheric gases), bacteriostatic control and mothproofing. These are the points on which research, development and application are concentrating, with particular emphasis on permanency. Permanency is the keynote for us all in the finishing of cotton, rayon and wool. After this war the housewife will know that she can buy a fabric, curtain or garment, that will retain its full flexibility, softness or firmness, and she will reject the old starched fabric that lost all these properties on rinsing. When "G.I. Joe" returns he will demand the dyestuffs that do not fade or bleed and the windbreaker that permanently sheds water, and the beach umbrella that does not rot.

Textile manufacturers and converters are all practically agreed that post-war fabrics will be permanently finished. The retailers, taking cognizance of the consumers growing consciousness of wash fastness of fabrics and apparel, are setting new standards, demanding textiles that are warranted as to color and shrinkage; and finishes that are resistant to the rigors of laundering. Too many fabrics lose most of their character and appeal after one laundering. Many attempts have been made during recent years to introduce to the trade laundry-resistant finishes with little success. For the most part this was due to the high finishing cost and the technical difficulties encountered. One of the most serious handicaps in the sale of these finishes, however, is the optimistic advertising that initially characterized these finishes as "permanent." "Permanent" in the mind of the buying public today seems to mean just that, even to the calendered effect, shrinkage and fastness of the dyes. A permanent finish will have little value on a garment having excessive shrinkage or when the fabric is dyed with fugitive colors.

If the consumer respect is to be kept claims of "permanence" must be watched. Even though some permanent finishes withstand 20-50 successive launderings, they do show some loss of hand through the action of the laundering. The fabrics, so treated, will nevertheless retain the definite and satisfactory characteristics originally imparted by the finish. What this war has done to our industry is important, particularly in the following respects:

1) It has given us valuable information on fabrics under the most adverse conditions from pole to equator.

2) It has compelled many mills to become familiar with intricate finishing operations which were formerly carried out only in a few well-equipped, well-staffed plants.

A permanent finish which has proven itself at war is water repellency. The progress made in the application of *durable water repellents* to cotton fabrics is something staggering. The types available today are quite intriguing in both application and performance. In the case of the two best known types, there is the suggestion of a bond to the fiber by reacting, for instance, stearoyl oxy methyl pyridinium chloride with cellulose to give the required water repellent cellulose modification. If investigation reveals this to be a fact then the road is open to a host of developments by using chemical radicals other than those giving water repellency.

* Presented at meeting, Rhode Island Section, March 23, 1945.

Another of the outstanding finishing developments which has great possibilities, is the mildew-proofing of cellulosic fabrics. Prior to the war the compounds for this existed, but little application whatever was made of them. The industry was very reductant to use compounds which are toxic to fungi or bacteria, fearing that they would also be toxic to man.

The compound dihydroxy dichlor diphenylmethane which has been applied to hundreds of millions of yards of ducks, webbings and also to yarn—simultaneously with water repellents, which are incorporated to increase permanency and give greater protection to the outdoor elements. This product can be applied from a solvent solution or an alkaline bath. Its peculiar constitution, resembling a naphthol, indicates close resemblance to dyestuff intermediates. Method of application is also like that of a dye.

Just recently it has been stated that this compound could be combined with quaternary ammonium compounds to give a very fast to leaching complex. This reaction points the way to a host of developments giving other lasting properties besides fungistatic, certainly bacteriostatic properties, and possibly water repellency, flameproofing, etc. It is well to observe this reaction because it indicates several new applications. It is possible even that instead of making use of the benzidine structure to obtain substantivity for dyestuffs that the quaternary ammonium compound could be used. It is well known that cation-active compounds of this nature interfere with light fastness of dyestuffs, particularly those of the direct color and acid groups. This is known to be substitution of the sodium solubility ion with the quaternary ammonium complex. Such interference would not necessarily result when a quaternary ammonium compound is united directly to a phenol as in the reaction above.

We now come to permanent finishes which modify the basic characteristics of cellulose fabrics.

From the results obtained in processing mosquito netting for Army use, using alkali soluble cellulose, experience has taught us that permanent finish and stabilization can be readily obtained by this means. Many plants are now set up to run such finishes. It is a peculiar thing that although these were available ten years ago, they were not able to introduce themselves in competition with starch. This can be explained only by the fact that no finishing plant could afford to use material costing ¼-½c per yard on the average fabric in place of a starch finish which has a chemical cost of practically nothing. Once the consumer demands such a finish, however, the finishing industry can apply the extra cost. Recently alkali-soluble cellulose types have been improved with the following advantages.

1) Right physical form, ready for use.
2) Considerable reduction in cost.
3) Application to the right fabric constructions with correct plant procedures.
4) Greatly improved versatility of application at stage of textile processing.
   a) in the greige
   b) in mercerizing
   c) after boil off or bleaching
   d) with dyestuffs and pigments durdyeing.
5) Better shrinkage control
6) Superior permanency.

The methods of application require:

Padding of solution followed by coagulation which can take place either by passing through acid or mercerizing baths or hot salt solutions or by drying. Best shrinkage control results where care is taken to dry the fabrics treated at or slightly wider than the required finished width.

Spun rayons as well as cotton can be processed with appropriate types (special viscosities). Mixed fibers offer good possibilities also.

Resins for non-crush and fabric stabilization have really been found excellent and durable (urea and melamine formaldehyde types). Unfortunately, they are subject to chlorine retention which difficulty is not experienced with soluble cellulose.

The woolen industry does not require the complex operations of the cellulose fibers. Here is a durable mothproof bathing suit, but the wool people prefer the moth as a customer. Will the synthetics make more inroads into wool fields or can the wool manufacturers go into new finishes and improve their operations?

Here we have a fabric which is used as an interlining cloth for aviators and also for troops in cold climates. It was designed primarily as a substitute for sheepskin linings. Sheepskins have great warmth, but are also very cumbersome and hamper movement of the body. This fabric has great flexibility and can be worn without encumbering. It consists of a mixture of cotton and wool, about 50-50, and is treated in one bath with mothproofing and water repellent finish. Millions of yards of this cloth have been produced and undoubtedly when the war is over it will be useful for civilian use. This garment is worn under a light cotton wind resistant material. The development of windbreaker cloth is very recent. During an American expedition to the Himalaya Mountains some years ago it was found that rather than to use several woolen fabrics for protection it was much more effective to have a woolen inner fabric near the skin with a very tightly woven cotton outer material on the outside. You have heard of Byrd Cloth, which was developed by Admiral Byrd during his expedition to the South Pole. This was a very lightweight fabric, almost as light as a man's shirting, which was given a water repellent finish and thus could be used during all weather. The idea of a lightweight outer garment has been used to great advantage by ski-troops.

Nowadays every soldier in the U. S Army has a windbreaker made of a cotton poplin which receives a permanent water repellent finish.

Millions of yards of fabric have been used by the U. S. Army for tenting, truck covers, pontoons, stretchers, haversacks, boots, and a host of other uses. Mildew repellents and water repellents have been used for such purposes. Similar constructions of canvas and duck are also made use of for water bags and must be given a mildew treatment which primarily must not be toxic. This is a very important consideration in the case of water bags. A water repellent finish is indispensable for the water *tanks*. In the case of the water *bag*, however, it is not. The bag filled with water is allowed to hang under a tree in the breeze. A slight amount of water seeps through the heavy canvas, evaporation occurs, and this tends to cool the water.

For stretcher cloth, mildewproof finishes and water repellent finishes are used. Here again it is important that the finishes used be non-toxic and non-irritant to the skin. Otherwise, contact with wounds would be disastrous.

For officers' raincoat material, semi-durable repellents are used to give a fast-to-dry cleaning, fast-to-washing finish on this material, which has been used in tremendous quantities. You will notice that it has a very bright, rayon surface and cotton back. It may appear strange that this fabric is used with the shiny side in. The fabric is also used by the parachute troops and the slippery side allows the parachuters to slide into them readily. On parade they are reversed and make a striking effect. This is an ideal fabric for postwar use.

Flameproofing finishes have come into their own in the last few years and certainly lessons like that of the Cocoanut Grove fire in Boston will teach us that all textiles in theatres, restaurants and public places should be made flame resistant so that they will not flame up on contact with a carelessly thrown cigarette or match.

The U. S. Army Specifications call for simultaneous flameproofing, waterproofing, mildewproofing and coloring. Such fabrics are used in camouflage which has called for quantities of cloth which run into hundreds of millions of yards. None of these would have been possible without the development of an industry which ran parallel to that of the application of dyestuffs.

O. D. Herringbone Twill, used for fatigue uniforms, is given a water repellent finish and could be used for working clothes.

A light cotton fabric used by the Army for sleeping bags has been given a mildew repellent plus water repellent, and can be used in contact with the ground without developing mildew and rotting.

There is another field of application of compounds in which you will be interested. The Army and Navy require soaps which can be used in any water in any location, including salt water. Ordinary soap is not suitable and will not foam or clean in salt water. A solution consisting of 50-50 soap and Igepon can be used to scour in salt water or any other water. It has been used in large quantities by the Navy, in laundries, for personal use, as well as the cleaning of ships' decks and painted surfaces. Here is the proof that synthetic detergent have proven themselves.

DISCUSSION

Q.—The speaker mentioned that the permanent cellulose finishes can be applied on greige goods *before* kier boiling. Does this interfere or in any way hinder the removal of moats and other natural impurities of cotton?

A.—There is no trouble in that respect whatsoever. The impurities can be removed and many practical applications are being carried out this way.

Q.—What can you tell about increasing the durability of fabrics?

A.—The increase in tensile strength is about 5 or 10 per cent which is not much, but there is a definite increase of abrasion resistance of the fabric (not individual filaments). Such an increase in abrasion resistance is important because it means better wearability.

Q.—After listening to the remarks about wool fiber, I would like to ask the question if there ever has been found a rayon, cotton, or synthetic fiber that would make a bathing suit as durable or as nice as wool, and one that does not shrink.

A.—I think that is easy to answer. How many woolen bathing suits do you see today? The suits you see are made of rayon and mostly elastic yarns. This is not a large field because the suits now are so small!

Q.—I am interested in the steps that have to be taken to be sure of the safety from a dermatitis point-of-view of these materials. We are in a war period where about everything goes; but how about the postwar problem?

A.—That is a good question. No doubt, after the war we are going back to a lot of ideas that certain compounds should not be used on fibers. However, these compounds are not different from some dyestuffs and both have been used for many years wtihout complaint. The structure is similar. O f course, there is a lot to be investigated. If there is to be trouble, the first men to have the trouble would be the manufacturer himself.

Q.—This is not necessarily true. Manufacturers use rosin derivatives in making surgical tapes, for instance. But certain people using these surgical goods get dermatitis. This sort of thing may bring out many new legal restrictions.

A.—I happen to be one of the allergic types. For instance, if I put on an adhesive plaster I break out and the same thing occurs to a lot of other people. But that doesn't mean that every compound on the market is going to cause trouble.

Q.—What do you consider adequate testing of materials before putting them on the market for civilian purposes?

A.—The patch test is made on at least 150 individuals before you can be sure that the compound is safe. Furthermore, injections should be carried out on guinea pigs.

Q.—Is it your opinion that if we had control on these materials as tested by the government (Surgeon General) that the civilian industry would be free?

A.—We have found the Government Bureaus very careful and reliable. Probably that is a question we should turn over to Professor Olney as a future research problem.

Q.—I think it is a very serious question as to what are going to be the standards of the new finishing agents that will be safe on new wearing apparel.

A.—I agree with you. They will need to be watched.

Q.—What percentage of the 150 people in the patch test would you consider high if the material was allergic?

A.—I think that if only five to ten people become allergic you can classify the test as negative.

Q.—Would there be any resistance to dyeing and printing of fabrics previously flameproofed?

A.—It all depends upon the type of flame-proofing compound used. It could definitely cause a lot of trouble, the same as pigment printing gives trouble.

Q.—Is there any form that could be used?

A.—I have not seen any satisfactory permanent form because the practical compounds used today are water soluble types. If the treated fabrics are printed and then washed, the flame resistance would wash out.

Q.—I am referring to that type of printed material that would not have to be washed or finished.

A.—I do not think you would have any trouble there.

CALENDAR OF COMING EVENTS

Meetings, Council and Research Committee, Hotel Commodore, New York City, October 5, 1945. Chairmen of Sub-Committees who wish to hold meetings on October 4th at the Hotel Commodore should notify Dr. Louis A. Olney.

Meeting, Piedmont Section, Hotel Charlotte, Charlotte, N. C., October 13, 1945. Election of officers will be held.

Meeting, New York Section, Downtown Athletic Club, New York City, October 19, 1945.

Meeting, Rhode Island Section, October 26, 1945.

PIEDMONT SECTION NOMINATES OFFICERS

THE nominating committee for the Piedmont Section, Henry B. Dixon, Chairman, announces the following nominations for next year's officers:

Chairman—Leland G. Atkins, Southern Dyestuff Corp., Charlotte, N. C.
Vice-Chairman—Wyss L. Barker, Allied Chemical & Dye Corp., Charlotte, N. C.
Secretary—John B. Neely, Burlington Mills Corp., Burlington, N. C.
Treasurer—Roy J. Beauregard, Fairforest Finishing Co., Spartanburg, S. C.
Custodian—Arthur R. Thompson, Ciba Co., Char. N. C.
Sectional Committee:
Edwin A. Briggs, Southern Franklin Process Co., Greenville, S. C.
Robert H. Smith, Melrose Hosiery Mills, High Point, N. C.
Fred E. Sprock, Geigy Co., Charlotte, N. C.
Winnifred A. Wardell, Rohm & Haas, Charlotte, N. C.
Councilors:
Sydney M. Cone, Proximity Print Works, Greensboro, N. C., 3 years.
Dr. Raphael E. Rupp, Pacific Mills, Lyman, S. C., 2 years.
Samuel L. Hayes, Ciba Company, Inc., Charlotte, N. C., 1 year.

The annual meeting for election of officers will be held in Charlotte, North Carolina, October 13 at the Hotel Charlotte. Hotel reservations must be made direct to the hotel. Banquet reservations must be made and paid for in advance to: Wyss L. Barker, National Aniline Division, Allied Chemical & Dye Corporation, Charlotte, N. C.

A record attendance is indicated for this meeting. Therefore reservations must be made early to insure accommodations. A program of unusual interest is being planned by the Charlotte committee headed by L. J. McGinty, Nyanza Color and Chemical Co., Charlotte, N. C.

pH CONTROL

(Continued from Page 362)

acid 60 per cent as a wool-dyeing assistant. Consequently, formic acid offers twice the value of acetic acid at present world prices. That the two acids are very similar in their behavior will be seen from the titration curves in Figure A and the tests in Table I. Formic acid is a reducing agent, and prevents attack on the wool structure when bichromates are used for chroming wool. In practical dyeing there are few instances where formic acid is not just as satisfactory as acetic acid, provided half the weight is used.

Method IV (a)—Mon-Ammonium Phosphate for wool dyeing is excellent for the following reasons:—

(1) It is easily available as pure white crystals, and it is cheap.

(2) Mon-amm. phosphate is an acid salt weaker than acetic acid. It neutralizes alkaline wools at low temperatures, like an acid. In this respect it has an advantage over ammonium sulfate, which does not acidify the wool until the temperature of the dyebath reaches the boil.

(3) Mon-amm. phosphate gives better exhaustion than ammonium sulfate, which is insufficient for a large number of acid and chrome colors.

(4) 5 per cent Mon-amm. phosphate is sufficient to ensure that all the wool acquires the same pH throughout.

(5) Mon-amm. phosphate provides dyebaths between pH 7 and 5.0, a pH range at which a large number of acid milling and chrome colors are best dyed.

(6) Mon-amm. phosphate provides a well-buffered dyebath, and dyeing recipes can be repeated with accuracy, irrespective of a varying wool to liquor ratios and wools of varying alkalinity.

(7) Mon-amm. phosphate in wool dyebaths gives a method of dyeing, which responds to temperature control as a means of controlling the dyeing rate, as distinct from ammonium sulfate, which requires high temperatures.

(8) Mon.amm. phosphate is the answer to the wool dyers' problem of dyeing many of the usually unlevel dyeing acid and chrome colors, without dyeing from an alkaline ammonium sulfate dyebath at the start.

(9) Mon-amm. phosphate controls the pH of the dyebath to a value at which wool suffers minimum damage, i.e., about pH 5.5 Wool dyed with mon-ammonium phosphate has a lofty handle and spins well.

(10) Mon-amm. phosphate prevents the dulling or drastic alteration in shade due to the presence of iron in dyeing chrome colors.

(11) For reasons of economy the mon-ammonium phosphate may be reduced to 2 per cent, particularly for pale shades, but the advantage of using excess is lost. To obtain well-buffered dyebaths at lower pH figures the amount of mon-amm. phosphate may be increased to 10 per cent.

(12) The many firms now using mon-amm. phosphate for dyeing loose wool, tops, yarn and pieces, at the author's suggestion, report no disadvantages.

Table III shows a comparison of the amounts of color exhausted in dyeings using 5 per cent mon-amm. phosphate, compared with 5 per cent ammonium sulfate. The amount of additional acid needed to exhaust the color is given, together with the pH of the exhausted dyebaths. From these pH values the most suitable method of dyeing may be chosen from Table II. Recommendations for the dyeing of any other dyestuffs will be gladly given on application.

PRACTICAL EXAMPLES OF DYEING WOOL WITH PHOSPHORIC ACID OR PROSPHATES

Method I.—Knitting worsted yarn, 50 lb. The yarn, previously scoured with a sulfated fatty alcohol, was immersed into a Hussong machine containing in solution at 120 deg. Fahr., the following dyes and chemicals:—

52 grams Alizarine Light Blue BGA conc. (S).

32 grams Xylene Light Yellow 2G (S).

9½ grams Azo Rubinole 2G 175 per cent (S).

1 lb. Sodium Salt of Iso-propyl Naphthalene Sulfonic Acid (levelling and wetting agent).

6 lb. Glauber's salt cyrstals (sodium sulfate).

860 grams Phosphoric Acid 90 per cent (equal to 3.8 per cent on the weight of the wool).

The dyebath was raised to the boil in 45 minutes, and boiling continued for 1 hour, 15 minutes. The pH of the dissolved chemicals without the wool was pH 2.0, and on completion of the dyeing the pH had risen to pH 4.4.

Method IV (a).—Peroxide treated knitting yarn, 108 lb. The yarn was lowered into a Hussong machine containing in solution at 140 deg. Fahr. the following dyes and chemicals:—

2 oz. 50 grains Brilliant Alizarine Sky Blue BS Pat (S).

30 grains Acid Violet 4BNS conc. (S).

140 grains Xylene Brilliant Cyanine G (S).

5 lb. Mon-ammonium Phosphate.

2 lb. Iso-propyl Naphthalene Sulfonic Acid (wetting agent).

pH of the dyebath without the wool was 4.7, and on completion of the dyeing 5.7. The dyebath was raised to the boil in 40 minutes and boiled 30 minutes. Then the yarn was reversed and boiled a further 20 minutes.

Method V (b).—Knitting yarn, 100 lb. In a Hussong machine the water was raised to the boil and the steam shut off. To this was added—

1666 ccs. Phosphoric Acid 90 per cent.

2000 ccs. Ammonia Sp. Gr. 0.88.

3½ oz. Bichrome.

1 lb. Sodium Salt of Iso-propyl Naphthalene Sulfonic Acid.

The yarn was immersed at 180 deg. Fahr., and circulated for 20 minutes. The yarn was then lifted out and the dissolved dye, 3½ lb. Sulphonine Blue RNC (C.I. No. 289), added, and then the yarn again. The temperature was raised to 205 deg. Fahr. in 15 minutes, and kept at this temperature for one hour, until the exhausted liquor showed a violet coloration. The pH of the liquor before adding the dye should be about pH 6.6. If preferred, the dye may be added to the chemicals at the start which is a quicker method, but not as safe as the former.

Method IV (b).—450 lb. Worsted Tops were packed into a Callebaut De Blicquy type dyeing machine, and were wetted out with warm water and a wetting agent; 12 lb. phosphoric acid 90 per cent and 22 lb. ammonium sulfate were diluted with water and added from the overhead tank. The dye, which comprised 20½ lb. Omega Chrome Black S 160 per cent (also know as Omega Chrome Black TDW 160 per cent). (Colour Index No. 203) was dissolved and then circulated through the wool at 110 deg. Fahr. The dyebath was brought to the boil in 45 minutes and boiled for 40 minutes. The pH of the dyebath before chroming was pH 4.2. The dyebath was allowed to cool, and 4½ lb. sodium bichromate dissolved, and run in and boiling continued for 30 minutes. If the overhead tank is large enough, a better method is to add the phosphoric acid, ammonium sulfate and dissolved dye altogether to the dry tops.

UNCONTROLLED pH DYEING METHODS

These are described as the methods of dyeing were the pH of the dyebath is not determined by the chemicals added. This is particularly the case in neutral dyeing.

TABLE III

Mon-Ammonium Phosphate Compared with Ammonium Sulfate

Column I shows the percentage exhaustion obtained with 5% ammonium sulphate, on the weight of wool, bath 1:50, after (a) 1 hour at 90 deg. C., and (b) after a further hour at the boil. Australian tops 58's quality (in 1½% oil) were used showing pH 8.1 (distilled water extract 1:30).
Column II shows the percentage exhaustion using 5% mon-ammonium phosphate, dyed similarly to column I.
Column III shows the amount of phosphoric acid 90% added to exhaust dyeings with 5% mon-ammonium phosphate, after 1 hour at the boil. Scoured worsted shirting was used, pH 9.5 (distilled water extract 1:30).
Column IV shows the percentage exhaustion after adding phosphoric acid 90%, where necessary, and boiling for 30 minutes longer. The figures in brackets show the color exhaustion before adding the acid.
Column V shows the pH of the dyeing tests of column III, using 5% mon-ammonium phosphate and exhausting with phosphoric acid. The figures in brackets show the pH before adding the phosphoric acid.
Notes.—The tap water used for dyeing showed pH 7.6.
Note the better exhaustion with the scoured worsted cloth compared with the greasy tops.

Name of Color Color Index No.	*Dyeing Method* (a) 1 hr. at 90 deg. C. and (b) after boiling 1 hr. longer	*I* 5% Ammonium Sulfate Percentage Exhaustion	*II* 5% Mon-ammonium Phosphate Percentage Exhaustion	*III* 5% Mon-ammonium Phosphate Phosphoric added to exhaust	*IV* 5% Mon-ammonium Phosphate Percentage Exhaustion	*V* pH Exhausted Dye-bath 1:30 Using Worsted Cloth
1% Omega Chrome Orange R	(a)	72	80			
C.I. 274	(b)	84	92	Nil	97	5.41
3% ditto	(a)	36	37			
	(b)	80	84	1%	98 (90)	5.40 (5.75)
1% Omega Chrome Brown EB	(a)	68	76			
	(b)	73	82	Nil	95	5.37
3% ditto	(a)	70	74			
	(b)	76	79	1.25%	97 (87)	5.00 (5.64)
1% Omega Chrome Red B 147%	(a)	76	84			
C.I. 652	(b)	94	96	Nil	98	5.94
6% ditto	(a)	65	69			
	(b)	81	84	0.5%	97 (95)	5.50 (5.67)
1% Omega Chrome Black	(a)	92	96			
Blue G	(b)	94	96	Nil	98	5.50
3% ditto	(a)	82	86			
	(b)	89	92	Nil	98	5.48
1% Omega Chrome Brilliant	(a)	80	82			
Blue B. C.I. 720	(b)	80	84	Nil	97	5.47
3% ditto	(a)	60	63			
	(b)	78	80	0.75%	96 (90)	5.30 (5.55)
3% Omega Chrome Brown 2R	(a)	77	88			
	(b)	90	93	Nil	96	5.81
1% Omega Chromaurine GL conc	(a)	40	44			
C.I. 219	(b)	60	66	Nil	96	5.42
4% ditto	(a)	39	37			
	(b)	50	76	2%	95 (93)	4.10 (5.57)
1% Chromosol Blue Black	(a)	68	74			
B 150% C.I. 1085	(b)	91	90	Nil	96	5.90
3% ditto	(a)	49	52			
	(b)	76	79	Nil	96	5.46
4% Sulphonine Red G	(a)	95	96			
	(b)	98	98	Nil	99	5.75
3% Xylene Brilliant	(a)	98	98			
Cyanine G	(b)	98	99	Nil	100	5.69
3% Xylene Brilliant	(a)	92	93			
Cyanine 6B	(b)	98	98	Nil	99	5.72
3% Xylene Fast Yellow P	(a)	77	82			
	(b)	92	92	Nil	98	5.90
3% Xylene Fast Red P	(a)	85	86			
	(b)	92	91	Nil	99	5.76
3% Xylene Fast Blue P	(a)	73	77			
	(b)	86	87	Nil	99	5.70
4% Xylene Fast Blue BL	(a)	93	95			
C.I. No. 833	(b)	94	95	Nil	100	5.70
3% Sulphonine Brilliant Red B	(a)	50	53			
	(b)	93	93	Nil	92	6.00
1% Acid Light Scarlet GL	(a)	44	60			
	(b)	82	91	Nil	99	5.58
1% Alizarine Light Green GS	(a)	65	75			
166% C.I. 1078	(b)	94	96	Nil	99	5.80
6% ditto	(a)	46	53			
	(b)	70	75	0.5%	97 (89)	5.53 (5.84)
3% Brilliant Alizarine Light	(a)	70	70			
Red B	(b)	79	85	Nil	96	5.83
3% Xylene Fast Violet R	(a)	33	35			
C.I. 758	(b)	63	60	1%	96 (88)	5.35 (5.66)

By this method scoured wool is dyed with the addition of Glauber's salt only. Usually the wool is far from neutral, but is alkaline at pH 9 or more. The method is often used for applying the neutral dyeing acid colors on union wool and cotton or rayon goods, and also frequently for Sulphonine Blue types (Colour Index No. 289). Dyeing proceeds from an alkaline bath, and may be prolonged, owing to varying color exhaustion, which is usually poor. The damage to the wool is quite intensive (16); the handle and finish of the material is impaired. All these objections may be overcome by the addition of ammonium sulfate as suggested by the present author and Smith (17), (18). By this means pH control is achieved.

The "Sweet chrome" mordant process is another process which gives varying results, according to the alkalinity of the wool. By this method wool is boiled in 3 per cent sodium bichromate for 1-1½ hours. In acid solutions the dichromate anion dominates, and in alkaline the chromate; whichever form is actually involved in mordanting, reduction to a chromic salt must take place before lake formation with mordant dyes can occur. There is considerable agreement that the chromic acid is reduced, especially above 60 deg. C., by the sulfur containing groups in the fiber (7). "Sweet chroming" is condemned, because the amount of mordant taken up depends upon the residual alkalinity of the wool, and also because some chemical destruction of the wool takes place. It is better to use the "Reduced chrome" process by adding a suitable amount of a reducing acid, e.g. oxalic, tartaric, formic or lactic acid or cream of tartar.

"Neutral" metachrome dyeing, by which metachrome mordant is the only addition to the dyebath, is criticized when dyeing proceeds from the alkaline bath. The method can be improved by ensuring that the wool is not unduly alkaline before dyeing. A sample of a dyed nigger-brown top recently tested by boiling in distilled

water showed pH 8.2, which indicated that the top had been dyed from an alkaline bath with a metachrome dyeing brown. It is preferable to use a chrome brown dyeing at a lower pH, e.g., Omega Chrome Brown EB.

THE LEVELLING EFFECT OF ANIONS

The action of Glauber's salt in reducing the exhaustion of acid colors (those dyeing at low pH values), but also giving a levelling effect, is well known, and has been explained previously (12) (17). On the other hand, it has been shown that with dyestuffs dyeing at higher pH values, there is no levelling action, but on the contrary, dyeings tend to be uneven, owing to the decreased solubility of the dye. To decide which colors are levelled by the action of Glauber's salt, tests can be made by completely exhausting the color without any addition other than acid, and then adding Glauber's salt. If the dyebath becomes colored, Glauber's salt will assist in levelling the color in normal dyeings. Contrary to the recommendations given in many text-books to increase the amount of Glauber's salt with the amount of dye, it would appear to be more logical to decrease the amount of Glauber's salt, particularly as color exhaustion is more important in deep shades and levelling more important in the pale shades.

Ammonium sulfate also has this levelling action, due to the sulfate anion, and where ammonium sulfate is used there is no need to add Glauber's salt.

Similarly, mon-ammonium phosphate may be expected to have a similar levelling effect, as the size of the anion is the same as the sulfate anion. This statement may be amplified to include the levelling effect of any phosphates created in the dyebath by using the methods in Table II. A small point is that the levelling effect of the phosphate anion is larger than the smaller anions of acetates and formates.

GREASY WOOLS

It is well known that the presence of moderate amounts of grease or spinning oil on wool reduces the dyeing rate and affinity for dyestuffs (15). Greasy wools may be therefore dyed at slightly lower pH values than normal wools.

CARBONIZED WOOLS

Carbonized pieces are usually washed free from excess sulfuric acid and then dyed with the addition of Glauber's salt, and often a further addition of sulfuric acid, with the easily levelling acid colors or metalized dyes, which dye at low pH values. On the other hand, if it is desired to apply the more neutral dyeing acid and chrome colors, the carbonized wool is either neutralized with soda or ammonia. This is a difficult process. A sample of "neutralized" carbonized wool showed on wetting out in cold distilled water pH at 6.8, but after boiling in distilled water for 30 minutes it showed pH 3.8. Thus it is not easy to prevent over or under neutralization. The addition of some phosphoric acid 90 per cent, say, 1-2 per cent, or some mon-ammonium phosphate (5 per cent) to the ammonia before using it, greatly assists in controlling the pH of the process, because the neutralizing bath is buffered by the phosphates, and excess ammonia will not render the wool too alkaline; if insufficient ammonia is added, the wool is only weakly acid. An additional point is that the pH of the bath may be more accurately tested by the use of this technique. Having brought the wool to the desired pH by this means, a suitable dyebath has been created, equivalent to Methods IV and V in Table II, and so it is now only necessary to add the dye and proceed normally. These remarks also apply to acid (sulfuric) milled goods, which have to be neutralized before dyeing.

CHLORINATED WOOLS

In the modern wet chlorination processes for rendering wool unshrinkable, the pH of the chlorinating bath is controlled by the use of phosphoric, formic or carbonic acids.

The affinity for dyestuffs, in the early stages of dyeing, is increased by chlorination, and dyeing is conducted at a higher pH than that for untreated wool. Therefore, ammonium sulfate or mon-ammonium phosphate is used for dyeing acid dyestuffs normally dyed from stronger acid baths, such as Xylene Fast Yellow 2GP, 2GW, RP, Xylene Fast Reds 2GP and BL and Alizarine Light Blue R.

PRACTICAL EXAMPLE

100 lbs. of men's knitted hose were chlorinated with about 3.3 per cent available chlorine.

The chlorinating bath contained in a paddle hosiery dyeing machine

3 lbs. Soda ash
5 pints Methylated Spirits
24 pints Sodium Hypochlorite (12½ per cent available chlorine)
5 lbs. Sandozol KB (wetting agent)
1920 ccs. Phosphoric Acid 90 per cent
300 gals. Water

The pH of the bath was pH 5.6.

The socks were added to the cold bath and circulated for 25 minutes. Then to the bath was added

5 lbs. Sodium Bisulfate (dissolved in water).

After 15 minutes, the bath was tested with potassium iodide solution to show the absence of chlorine. After two cold rinses with cold water the socks were dyed.

Dyeing Method. The following were dissolved and added to the bath

5 lbs. Mon Ammonium Phosphate
½ pint Ammonia Sp. Gr. 0,88.

The temperature was raised to 120° Fahrenheit and the dissolved dyestuffs added consisting of

0.250% Xylene Fast Yellow RP (S)
0.170% Xylene Fast Red 2GP (S)
0.340% Alizarine Light Blue BGA (S)
pasted with ½ pint Tetracarnit.

The dyebath was raised to the boil in 30 minutes and boiled 1½ hours. After rinsing with cold water the socks can be softened if desired with the addition of 0.25% Ceranine HC dissolved in water.

Dri-sol treated goods are washed free from the white spirit and neutralized with ammonia to about pH 4-5, if it is desired to dye with the above-mentioned dyestuffs. In this case it is also an advantage to add some mon-ammonium phosphate (3 per cent) to stabilize the pH of the bath before adding the dye. If the faster-to-washing and milling acid or chrome colors are to be applied, then it is necessary to neutralize the dri-sol treated wool to pH 7-8 with ammonia. Here, again, the addition of some phosphoric acid or mon-ammonium phosphate is an advantage in controlling the pH of the neutralizing bath, just as it is in the case of carbonized wool. Having ensured that the wool has acquired the same pH throughout, i.e., pH 7-8, it is then only necessary to add the dye and proceed normally.

The dry chlorine (W.I.R.A.) process on white tops or pieces leaves the wool at about pH 4.6. The goods may be dyed satisfactorily, without pretreatment, with acid or metallized dyes (Neolans, Vitrolans) at low pH values. The faster-to-washing acid colors may be applied by the addition of 5 per cent mon-ammonium phosphate and dye only. To dye many of the acid milling and chrome colors, it is necessary to neutralize the wool to pH 7-8 with ammonia. Here, again, the addition of mon-ammonium phosphate (3 per cent) is an advantage in stabilizing the pH of the neutralizing bath. The dye is then added, and normal procedure followed.

In the Melamine resin non-shrink process the wool is impregnated with the resin in water, and diammonium hydrogen phosphate is used as an accelerator and to buffer the pH of the bath. Care must be taken to see that the pH of the bath does not drop unduly when treating

dyed wools, showing low pH values (on extraction with boiling distilled water).

SUMMARY

The buffering action of phosphoric acid and phosphates has been discussed, and the novel advantages of using this technique to control the pH of pre-treatments and dyeing processes have been demonstrated.

All chrome and acid colors may be advantageously dyed *with suitable mixtures of phosphoric acid and ammonia.* It may be more convenient to use mon-ammonium phosphate, as suggested.

ACKNOWLEDGEMENTS

The author wishes to express his appreciation for the electrical pH tests and titrations made by Miss R. Hope, of Holeproof Ltd.; the assistance of the staff of Messrs. N. W. Richards and Co., and for the facilities provided by these firms.

REFERENCES

1. Hambly—"Textile Journal of Australia," January, 1942.
2. Dole—"American Dyestuff Reporter," April 28, 1941.
3. Townend—"Journal of the Society of Dyers and Colourists," June, 1944.
4. Speakman — "J.S.D.C.," May, 1925: November, 1934; April, 1936.
5. Goodall—"J.S.D.C.," February, 1937.
6. Steinhardt, Fugit and Harris—"Textile Colorist," January, 1943.
7. Giles—"J.S.D.C.," November, 1944.
8. Elod—Trans Faraday Society, 1935, 215; Agnew, Chem., 1928, 41, 14.
9. Peel—"J.S.D.C.," December, 1944, page 330.
10. Hirst and King—"J.S.D.C.," 1937.
11. Britton—"Hydrogen Ions," p. 257, Vol. II; p. 303, Vol. I.
12. Noble—"Textile Journal of Australia," April, 1944.
13. Mercer—"The Felting of Wool," J.C.S.I.R. Aust., Vol. 15, No. 4, 1942.
14. Smith and Harris—"Nat. Bureau of Standards," Vol. 16.
15. Kienle, Royer and McCleary—"American Dyestuff Reporter," January 29, 1945.
16. Speakman and Coke—"J.S.D.C.," December, 1938.
17. Noble—"Textile Journal of Australia," July, 1942.
18. Smith—"J.S.D.C.," January, 1945.

Notes on the Stripping of DYED TEXTILE MATERIALS

J. WAKELIN

IT is perhaps an appropriate time to review the familiar and a few of the newer processes for stripping and decolorizing textile materials. It is not a field which on its own account is normally profitable for research and investigation, but advances in other related spheres of textile chemistry occasionally afford indirect assistance to the carrying out of stripping. These will be mentioned in the following notes.

ACID DYES ON WOOL

If only a partial decolorizing effect is required, made necessary by a fault in matching up, for example, the goods may be toned down by running in a hot neutral liquor containing only sulfate of soda. A more pronounced stripping is produced if a little ammonia is added to the bath, but if the same goods are afterwards to be dyed again, care will be needed to ensure that the stripping is evenly done. Again, on withdrawing from the bath, the woolen material now slightly alkaline will need to be neutralized and this can be done by running through a weak vitriol or acetic acid bath. Very uneven effects can be caused if the process of running in alkali and then again in a fresh dyebath is done too hastily, the liquors not having been given time to reach all parts uniformly.

A more drastic removal of dye from wool requires the use of acidified hydrosulfite or some similar preparation. As before, if levelness is to be expected on re-dyeing, care and patience in the stripping and washing off will be needed.

It is worthy of note that stripping with sulfur compounds does not automatically give a lighter shade in the same tone; some dyes give lighter shades of a very different hue, so that re-dyeing becomes a more complex matter. This phenomenon of color change in stripping was the subject of a patent some years ago, but the process never came into general use. The idea was to treat dyed fabrics with zinc dust and bisulfite of soda in order to yield new shades, the method being termed "dyeing down." The existence of such a proposal illustrates the unpredictability of stripping processes if nothing more.

DIRECT COLORS ON VEGETABLE FIBERS

The presence of soda ash in a dyebath for substantive dyes has a generally restraining effect and so this may in certain cases be turned to good account in treating over-dyed material. For more thorough stripping, however, hydrosulfite is usually employed. Sometimes special "solvents" may be added to the stripping bath with advantage when dealing with dyes of the oxyphenine type, for example, cyclohexanone and pyridine.

Pyridine and certain derivatives, notably fatty quaternary pyridinium salts have proved themselves useful adjuncts in color removing processes. Pyridine itself is often a great help and may be used alone or mixed with varying amounts of water. Zuehlke (*Textilberichte*, 1936) states that many direct cotton dyes are not removed by treatment with dry, water-free pyridine, whereas they are readily stripped by aqueous pyridine mixtures. On the other hand, dry pyridine shows preferential stripping powers over aqueous pyridine for some mordant and naphthol combinations.

AZOIC COLORATIONS

The faster the dyestuff and the greater its binding power to the fiber, the less easily is it stripped with satisfaction. For the faster azoic combinations it is best to use sodium formaldehyde sulfoxylate preparations made just acidic with acetic acid. There are some very efficient proprietary mixtures on the market for tackling such dyeings. The effectiveness of these products lies in the combination of chemicals to loosen the dye and another to disperse and render removable the resulting coloring matter. Quaternary fatty nitrogen and pyridine compounds are used for the second purpose.

Thus, in British Patent 400,239, cotton dyed with the combination, 4-chloro-2-toluidine coupled to the 5-chloro-2-toluidine of 2:3-oxynaphthoic acid, is completely stripped on boiling for 30 minutes with aqueous sodium formaldehyde sulfoxylate neutralized with acetic acid, to which has been added some cetyl-trimethyl-ammonium bromide. In another example, cotton dyed with a similar fast azoic combination is almost completely stripped by treatment at the boil for 10 minutes with sodium hydrosulfite, soda ash and a little of the compound 2-hydroxyethyl - N - octadecylmorpholinium bromide.

The chemicals used may seem to have formidable and unpronounceable names, but they are examples of cation-active agents used to promote dispersion, and are of such a nature that their properties are not lost in contact with certain other reducing and acidic chemicals used for attacking the dyestuff on the fiber. When the fabric is immersed, some particles of dye are detached and the cation-active agent disperses them and makes them more amenable to further chemical attack and destruction. Even completely insoluble dyes form weak colloidal solu-

tions in the presence of such reagents. They improve the stripping action and result in better color clearance.

British Patent 436,076 likewise deals with the stripping of azoic dyeings using somewhat similar assistants in the bath.

VAT DYES STRIPPING

The most efficacious method of removing fast vat colorations is to treat them with alkaline hydrosulfite at the boil, but while the color is temporarily lost, if given the opportunity and if the fabric is exposed to air, the color returns. According to a statement in British Patent 409,336, magnesium sulfate should be added to the bath after 30 minute's boiling has been completed. Although no explanation is offered in the specification, it seems likely that the metal salt precipitates and inactivates the reduced leuco dye.

The well-known vat color Caledon Jade Green may be stripped from cotton fabrics by treatment in an alkaline bath at 90 to 95 deg. C. containing sodium hydrosulfite, caustic soda, soap and cetyltrimethylammonium bromide. (British Patent 422,466.) Here we see one of the quaternary cationic agents being used again. Only a weak green tint remains after treatment.

ACETATE RAYON DYES

A gentle stripping action is obtained by working the material for a time in hot, half per cent soap solution, to which may also be added a little active charcoal. The mechanism involved is simply a reversal of the usual method of applying dispersed dyes.

The removal of dye from acetate rayon by solvents in mixture is the subject of British Patent 513,077 to a prominent company in the industry. There is potential danger in using solvents of any kind in conjunction with cellulose acetate because it is so readily swollen or even dissolved by organic liquids, but the present invention prescribes a combination of a chlorinated solvent such as methylene chloride, which on its own is said to exert an excellent stripping action, plus an equal or rather greater proportion of inert, hydrocarbon, such as petrol. Acetate yarn dyed with oxy-amino-anthraquinone is said to be very completely stripped if moved about in such a mixture at room temperature for 5 to 10 minutes.

MISCELLANEOUS AIDS FOR STRIPPING

As is already clear, most chemical stripping agents depend upon the use of reducing agents, which attack the dye substance and decompose it or convert it into some colorless derivative or degradation product. In the chemical sense a reducing agent is one which abstracts oxygen atoms or alternatively, donates hydrogen atoms. Any substance which tends to aid the transfer of hydrogen from the stripping agent to the dye or compound being stripped, will have a generally helpful influence and such an individual function as a "hydrogen carrier." Anthraquinone which is itself readily reducible and capable of being re-oxidized, is such a carrier and its presence in stripping liquors is often advantageous. Even when present in small amounts, less in quantity than the other reagents, it assists the reducing action of hydrosulfites and similar preparations. In other words, it is a form of catalyst.

If anthraquinone is useful, it seems logical to ask whether this principle could not be developed and better catalysts found. According to British Patent 548,-558, sodium anthraquinone sulfonate is to be preferred to anthraquinone and is so effective that milder stripping agents may be used in conjunction with it to give similar results. Thus, the inventors state that a simple mixture of 2 per cent glucose, 1 per cent soda ash and 0.1 per cent of this body in an aqueous bath, is capable of stripping a red dyeing of naphthol and paranitraniline on cotton, working for 15 minutes at 80 deg. C. Such a mild reagent would appear to be safer for rayons and finer fabrics from the standpoint of deterioration, than for example many known stripping salts which are notoriously searching.

Another stripping agent for special purposes is papain. This enzymatic preparation can be employed for removing colorations produced by pigments fixed with albumen. A bath for the purpose (British Patent 468,154) contains sulfide of soda, soda ash, sugar, dextrin in addition to the papain itself.

The Potentialities of

PAPAIN IN THE TEXTILE INDUSTRY

J. WAKELIN

THERE is nothing essentially novel in the idea of utilizing enzyme preparations as assistants in the treatment and finishing of textiles. The removal of starch from fabrics with the aid of amylases has been known for a considerable time and pancreatic enzymes which attack proteins have long been used for degumming silk. In both these instances enzymes assist degradation processes but it does not follow that they cannot be put to more positive and constructive use. The aim of this account is to show how varied are the ways in which the proteolytic enzyme known as papain can be used in the wet processes of the textile industry. If for no other reason, enzymes commend themselves to the textile technologist because they are relatively gentle and specific in their action so that there is the minimum risk of spoilation involved for other fibers or materials present.

Papain is the dried juice of the papaya tree which is grown in Ceylon and other countries in the East and appears commercially as a whitish or brown, dry powder. Some 58 tons were exported to U. S. A. during 1937. Chemically, papain is a protein with a molecular weight of about 27,000 and contains cystine amongst other amino acids. It has a very powerful destructive effect on wool keratin when applied in conjunction with sodium bisulfite which makes the chemical reactive groups in the wool accessible. A solution of 1 part papain in 40 parts of water will convert wool into a mass of cortical cells in 17 hours if bisulfite is present. The slow action of papain on wool is probably due to the fiber's compact structure and the ramifications of the cross linkages. Once these are broken down, the enzyme can begin its work.

While papain appears to be particularly suited for the treatment of wool it may also be used for removing sericin from silk mixture fabrics. Thus, it operates best in a neutral or slightly acid solution and is reasonably safe for most fibers. For limited periods the temperature may be raised to 60-70 deg. C. As stated, papain acting alone is usually slow and it is advantageous to have sodium thiosulfate or hydrosulfite present in the same

bath as "activator."

PAPAIN FOR STRIPPING

Textile fibers may be colored by pigments applied with the aid of albumen as fixative, and where it is desired to decolorize, ordinary stripping agents are of little avail. According to British Patent 468,154, papain may be employed using a bath such as the following.

Papain	2.5 kilos
Sulfide of soda (fused)	1.25
Soda Ash	5
Sugar	61.25
Dextrin	30

The combination is dissolved in 5,000 liters of water and the bath used at 75 deg. C. for stripping textiles having albumen (e.g., gelatine) fixed colors. The same bath is also applicable to leather.

WASHING TEXTILES

Soiled fabrics, whether of silk, cotton or linen may be cleansed with advantage in an aqueous solution containing papain, soap, soda and sodium polysulfide. After impregnation at 40 to 80 deg. C. the textiles are given a boil in water or soap solution. It is not immediately obvious what purpose the papain serves in this, British Patent 475,880, but it is conceivable that it helps in the removal of waste matter likely to be found in garments worn next to the skin.

WOOL MADE NON-FELTING

It is known that the phenomenon of felting in wool is intimately bound up with the surface physical characteristics and it has recently been found possible to modify the fiber by treating it with a solution of papain. The process is slow if the enzyme is used on its own but markedly accelerated if sodium bisulfite is present at the same time. In the latter case the dithio groups in the surface keratin are reduced to thiol (—SH) groups which are more amenable to the enzyme.

As is common experience with other enzyme preparations, the pH value of the bath is highly important. A solution for treating wool is made up by dissolving 1 part of commercial papain in 4,000 parts of water, to which is added for activating 40 parts of sodium bisulfite. Sodium carbonate is added until the pH registers 6.7 and the temperature adjusted to 65 deg. C. Wool is treated in such a bath for 10 to 60 minutes depending upon the fineness (longer for finer fibers). The treatment should not be carried on too long as there is a gradual deterioration of the fiber and loss in weight. A loss of between 1 and 3 per cent in weight corresponds with an appropriate degree of attack and means that an adequate reduction of felting has taken place. (British Patent 513,919.)

PHYSICAL PROPERTIES OF WOOL MODIFIED

The papain method of rendering wool less liable to felt appears at first sight to be widely divergent from previous methods. The underlying principle is similar, however. The "Drisol" process employs sulfuryl chloride in an inert solvent, white spirit. The latter does not cause the wool to swell and hence the modifying action takes place almost entirely on the fiber surface.

Another recent method employs caustic soda dissolved in alcohol, which again does not produce swelling, so that only the surface layers of the wool are attacked.

Papain appears to confine its activity to the surface, because, it is believed, the molecules are very large and unable to penetrate the fiber even when swollen by contact with water.

The question of felting has been much studied in many textile schools during the last decade and no doubt even more satisfactory methods of modifying animal fibers will be found in the future. In the meantime, the recent British Patent 546,915 illustrates the possibilities when two different processes are combined. When wool is treated with gaseous or nascent chlorine, it loses its tendency to felt, and this was in fact the principal method of carrying out the process until a few years ago.

Now, it appears that when wool attacked by chlorine is afterwards subjected to the action of papain, the degraded wool substance which remained on the surface after chlorination is removed by the enzyme and the fiber acquires a silk-like gloss and a scroopy handle.

An example of the process is as follows: 100 parts of an unscoured worsted fabric of 64's wool is dried until 7 per cent moisture is left in and it is then gas-chlorinated by the process described in British Patents 417,719 and 475,742.

The liability to felt is thus reduced or removed and the fabric is neutralized, scoured and then run in a papain solution for 2 hours at 65 deg. C. 0.3 parts of papain, 3.1 parts each of sodium acetate and bisulfite are dissolved in 1250 parts of solution and while the fabric is in contact with the liquor, acetic acid is added to give a pH value of 5.0.

The fabric is finally neutralized, milled with soap for an hour and rinsed first with water then with a dilute solution of sodium hexametaphosphate. The fabric possesses a silky appearance and has scroopy handle after drying.

TRADE NOTES • NEW PRODUCTS

OBITUARY

HORACE BURROUGH III

HORACE BURROUGH III, Assistant General Manager of Sales for Monsanto Chemical Company's Merrimac Division, died of a heart attack on August 8 at his home in Swampscott, Mass. He was 49 years old.

A native of Brunswick, Maine, he was educated in the grade and high schools of Baltimore and Port Deposit, Maryland. He attended Johns Hopkins University and in 1919 received his Ensign's commission at the U. S. Naval Academy. At Johns Hopkins, he was a member of the Phi Gamma Delta Fraternity. He remained in the Navy until 1923, his rank having been raised to that of Lt. j.g. in 1919.

He entered Monsanto's service in 1924 working in the engineering and manufacturing department until 1928. From 1928 until 1932 he was an assistant in the sales department. He then became assistant sales manager and in 1935, sales manager of heavy chemicals and alcohol. His promotion to the position of Assistant General Manager of Sales of Monsanto Chemical Company's Merrimac Division followed in 1944.

Surviving are his wife and a daughter.

HENRY L. BLUM

HENRY L. BLUM, a founder and former president of the United Piece Dye Works, Lodi, New Jersey, died on August 22nd at his home at Scarsdale, N. Y. He was 74 years old.

He was born in France and came to this country at an early age. He studied at Columbia University and Philadelphia Textile School. With his father and three brothers he founded the dyeing firm in 1892. He retired from active business in 1937 but was a director and chairman of the executive committee at the time of his death.

Mr. Blum was a director of the French Hospital, New York, and a former director of the du Pont Rayon Company.

He is survived by a widow, two sons, a daughter and brother.

• SANDERS-EAVENSON CHEMICAL COMPANY

The Sanders-Eavenson Chemical Company has been formed with headquarters at 55 Liberty Street, New York City, which organization will act as distributors for nationally known lines of products for distribution to the leather, paper, food and beverage, textile, metal cleaning, rubber, laundry, dry cleaning and hospital

trades. They will have manufactured for them, from their own specifications, sulfonated oils, synthetic detergents and special lines of cleaners for industry and household use. They also plan to develop specialized formulated products for the industrial, retail and consuming trade.

Marvin S. Eavenson, one of the partners, was formerly associated with J. Eavenson & Sons of Camden, New Jersey, where he served as Sales Manager and later in the capacity of Factory Manager after this organization had been sold to Wilson & Company, Inc., the Chicago packers. In 1924 he organized the Industrial Soap Department for Colgate & Company, acting as Sales Manager up to the time of the merger between Colgate & Company and the Palmolive Peet Company. Subsequently he served as Eastern Territorial Manager for the merged companies until 1940, leaving to organize Division "H" of the National Oil Products Company of Harrison, New Jersey. He resigned from National Oil Products to join the Wyandotte Chemicals Company as their Chicago Manager, resigning on May 1st of this year.

James W. Sanders for many years headed the J. W. Sanders Company, mill representatives for various iron and steel products. He later entered Wall Street and became a partner in the firm of Diefendorf, Sanders and Ward. During the war period, Mr. Sanders has been engaged in the manufacture of plastic enclosures for aeroplanes, being part owner and Executive Vice-President and Sales Manager of the Plastic Moulding Corporation of New York City.

• HOOKER BULLETIN

Hooker Electrochemical Co., Niagara Falls, New York, has issued a bulletin entitled "General Products List, Bulletin 100." This is a handy, file size folder containing information on nearly 100 chemicals. A brief description of each product is given together with a list of chief uses and shipping container information. Several new chemicals are listed for the first time. Copies of the bulletin are available upon request.

• JOINS N. C. STATE COLLEGE

Dr. Frederick T. Peirce, former head of the Testing Department of the Shirley Institute of England, the world's largest and oldest textile research organization, has been appointed as director of textile research of the N. C. State College School of Textiles, it has been announced by Dean Malcolm E. Campbell, head of the School of Textiles.

Dr. Peirce, a native of Queensland, Australia, resigned his post at the Shirley Institute at Didsbury, Manchester, England, to accept the State College position. He had been a member of the Institute's staff for 24 years.

Dean Campbell outlined the accomplishments of Dr. Peirce as follows:

"During World War I, Dr. Peirce served in the Australian army as a wireless technician, and later in the Sixth Australian Light Horse Regiment until he was wounded in combat in the Middle East. In the present war he has been responsible for a number of outstanding textile developments, including cotton fire hose and the well-known 'Shirley cloth' for raincoats used by both the British and U. S. Armies.

"He was brought to this country in November, 1944, as a technical expert on the British Ministry of Supply Mission, at the request of the U. S. Quartermaster Corps. Later he spent a month in Ottawa at the invitation of the Canadian Government and returned to England in February of this year.

"Among his publications, which number about forty, are a series entitled 'Tensile Tests for Cotton Yarns,' 'The Fineness and Maturity of Cotton,' 'The Serviceability of Fabrics,' 'The Geometry of Cloth Structure,' 'Molecular Co-ordination in Cellulose,' and 'Cotton Research and Academic Physics.' He has also been responsible for more than 10,000 special reports and confidential memoirs to British textile mills, Government departments, and users of textiles.

"In his new position at the State College School of Textiles, Dr. Peirce will develop and direct the program of fundamental and applied research, with particular emphasis on new-fabric development. He will also lecture to students in fiber properties, textile testing, and mechanical fabric design, both at the graduate and under-graduate level."

• RAMASIT KT EXTRA

General Dyestuff Corp., 435 Hudson Street, New York 14, N. Y., is offering a new water-repellent of the Ramasit K type known as Ramasit KT Extra. The product is substantially the same kind of product as Ramasit KE Concentrated but with a higher wax content. The product contains neither glue or gelatine.

Ramasit KT Extra is applicable to cotton, rayon, and wool fabrics. On cotton and rayon fabrics the water repellent effect is removed by dry cleaning but on wool is durable.

• JOINS PHILA. QUARTZ

Dr. Reynold C. Merrill, formerly with the U. S. Dept. of Agriculture Regional Laboratory, Albany, California, recently joined the Research Staff of the Philadelphia Quartz Company, Philadelphia, Pa., manufacturers of sodium and potassium silicates. Dr. Merrill received his Ph.D. from Stanford University in 1942, where he worked under Prof. J. W. McBain in the field of soap-phase research. His commercial experience has also included affiliation with California Cotton Oil Corp. and with Lever Brothers at Cambridge, Mass.

• ELECTED TRUSTEE

Herman Chopak, President of the Chopak Textile Co., Inc., New York rayon converters, has been elected a Trustee of The Philadelphia Textile Institute Foundation, it was announced recently.

Mr. Chopak is also President and Board Chairman of the Textile Distributors Institute, Inc., and Chairman of the Rayon Textile Advisory Council for returning war veterans. He will serve as Vice-Chairman for New York of the Philadelphia Foundation's $2,000,000 campaign for increased textile education.

• JOINS BJORKSTEN LABORATORIES

Stuart O. Fiedler has joined the staff of Bjorksten Laboratories, 185 N. Wabash Ave., Chicago 1, Illinois, as a research associate.

Stuart O. Fiedler

Mr. Fiedler was for several years connected with the C. F. Burgess Laboratories as a research chemical engineer. Subsequently he was research chemist and group leader for 15 years for E. I. du Pont de Nemours & Co., Inc. He left this position to become technical supervisor of the protein plant of the Drackett Co. and later was supervisor of textile research in the Quaker Chemical Products Corp.

Mr. Fiedler is a member of the American Association of Textile Chemists and Colorists.

• HERCULES APPOINTMENTS

William R. Ellis and Mahlon G. Milliken have been elected vice-presidents of the Hercules Powder Company, Inc. Mr. Ellis has been general manager of the Explosives Department and Mr. Milliken, general manager of the Cellulose Products

Department. Philip B. Stull, now a vice-president, Mr. Ellis and Mr. Milliken were elected members of the executive committee.

John J. B. Fulenwider has been appointed general manager of the Cellulose Products Department and J. B. Johnson, general manager of the Explosives Department to fill the vacancies caused by the election of Mr. Milliken and Mr. Ellis as vice-presidents.

● JOINS GALLOWHUR

Allen B. Clow has been appointed to the newly created position of Executive Vice-President and General Manager of Gallowhur Chemical Corporation, with executive offices at 801 Second Avenue, New York 17, N. Y., and factories in Jefferson, Mass., Windsor, Vt., and New Rochelle, N. Y., according to an announcement by George Gallowhur, President.

Allen B. Clow

Mr. Clow was formerly assistant to the General Manager of Calco Chemical Division of American Cyanamid Company. During his twelve years with Calco he served also as Advertising Manager, and as Sales Manager of the Household Products Division. Prior to holding an executive position at Calco he was connected with Johnson & Johnson.

● AMERICAN VISCOSE CONFERENCE

At the invitation of the American Viscose Corporation, the deans of the country's leading textile schools and their representatives held a two-day conference on August 7 and 8 at the company's Textile Research Department at Marcus Hook, Pa. In addition to studying the work of the Textile Research Department, the group inspected the company's Chemical Research Department, Standards Department, and the local Marcus Hook rayon producing plant.

The chief purpose of the conference was to acquaint the textile school representatives with the types of technical information concerning rayon and allied products that are available to them from the research departments, laboratories and production personnel of the American Viscose Corporation. It is felt that closer cooperation of this nature should be helpful in the planning and presentation of the courses given to textile school students.

● MORE ETHANOLAMINES AVAILABLE

Larger facilities for the production of monoethanolamine and diethanolamine have just been completed by Carbide and Carbon Chemicals Corporation, a Unit of Union Carbide and Carbon Corporation. A new production unit is now in operation to meet the increasing demands on these two important amines for chemical uses, gas purification, and emulsifying agents. Chemically active, monoethanolamine and diethanolamine react both as alcohols and amines. As mild bases they combine directly with acids and acid gases and are useful for removing acid gases from natural gas and crude hydrogen. They are particularly useful also in the concentration of carbon dioxide. Both are said to be excellent for making amine-soap emulsifying agents, but monoethanolamine is preferred when an amine with a low combining weight is desired. Diethanolamine is said to be a valuable intermediate in many organic syntheses, especially in the preparation of wetting agents and detergents.

● ACID-RESISTANT VINYON SHIRTS

Special acid-resistant work shirts made of "Vinyon" have been made by the American Viscose Corporation for the use of employees in the spinning departments of several of its plants where employees and their clothing are daily exposed to contact with acids.

Reports to date on the "Vinyon" shirts indicate that they are giving exceptional service and show no harmful results from constant exposure to acids.

The shirts are of an open knit construction and are not intended to provide protection against possible acid burns. Their purpose is to provide a practical work shirt that will stand up under repeated contact with strong acids.

● NEW ARIDYE CLEAR

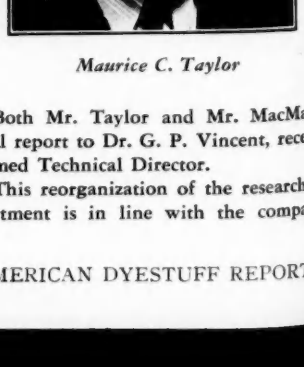
A new, all-purpose printing clear which is said to offer several important advantages over previous types has been announced recently by Aridye Corporation, Fair Lawn, N. J. An outstanding feature of this new product, known as Clear 6214, is said to be that it permits plissé effects to be obtained with the regular line of Aridye* pigment colors. The color value and fastness properties obtained are claimed to be equal or superior to those with older types of clears. Among other advantages claimed for Clear 6214 are the following: (1) excellent stability during storage and on running; (2) excellent flowing properties, permitting better control of viscosity than was possible heretofore; (3) good stability to hydrosulfite employed in discharge printing; (4) good stability to acid, hence giving excellent results on naphtholated grounds; and (5) colorless and transparent, providing the full brilliancy of pigment colors.

Entirely different in chemical constitution from previous products, Clear 6214 is the result of over twelve month's work in the Research and Development Laboratories of Aridye Corporation. After being subjected to rigorous tests in the Aridye Application Laboratories, field trials were made in several printing plants. It is stated that when these mill trials proved the superiority of Clear 6214 over existing types, commercial production was started, and this new all-purpose clear is now offered to the trade to replace Clears A-767, C-521, and C-221.

* Reg. U. S. Patent Office.

● MATHIESON CHANGES

Maurice C. Taylor, formerly Manager of Research at the Niagara Falls Laboratories of The Mathieson Alkali Works, has been appointed Resident Director of Research and Development, according to an announcement by George W. Dolan, President. Other Research Department changes are announced as follows: J. Douglas MacMahon, heretofore Assistant Manager of the Sales Development Department, has been named Assistant to the Technical Director; C. N. Richardson, Superintendent of Pilot Operations, becomes Manager of Research Engineering; and C. Gerald Day, a Superintendent in the Development Department, becomes Research and Plant Liaison Engineer.



Maurice C. Taylor

Both Mr. Taylor and Mr. MacMahon will report to Dr. G. P. Vincent, recently named Technical Director.

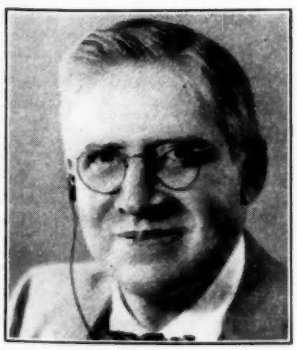
This reorganization of the research department is in line with the company's

policy of continued aggressive research and the coordination of sales development and plant operations with research, Mr. Dolan stated.

Mr. Taylor, who received his B.S. degree from Purdue University and then served in the Chemical Warfare Service, has been with Mathieson since 1919. Starting as a research chemist, he later became Chief Research Chemist, then Assistant Director of Research, and, in 1941, Manager of Research. In his new post, Mr. Taylor will consolidate all departments of research and development, including research engineering. Mr. Taylor's research work is covered by 26 U. S. patents, many of which have foreign equivalents.

J. Douglas MacMahon

Mr. MacMahon's new post puts him in direct charge of product development, as regards both new products and improvements in present products. A graduate of Cornell University, he joined the Mathieson organization in 1922 as Technical Representative and was made Assistant Manager of the Sales Development Department in 1941. He has developed several patents covering applications of Mathieson products.



C. N. Richardson

Mr. Richardson, who takes over the direction of research engineering, received his degree in electrochemistry from the Massachusetts Institute of Technology in 1916. He served in the U. S. Army during the first World War, and after four years with the U. S. Department of Agriculture joined Mathieson in 1924 as a research engineer. He was put in charge of pilot operations in 1944.

C. Gerald Day

Mr. Day will assist Mr. Richardson, serving as liaison between the managers of all the Mathieson plants and the engineering department at Niagara Falls. He received his degree at Columbia University, and worked for du Pont before joining Mathieson in 1930 as a chemical engineer. He spent some time as the Superintendent of the Development Department of the Mathieson plant in Saltville, Virginia, and then as chemical engineer at the Niagara plant.

● 35TH ANNIVERSARY WITH PHILA. QUARTZ

William Martin, Vice President in charge of Purchasing and Traffic of Philadelphia Quartz Company, manufacturers of silicates of soda, celebrated on August 1st, thirty-five years of continuous service. He was tendered a testimonial luncheon by the officers and directors of the Company, at which time a gold service emblem with a diamond was presented to him.

● SYNTHETIC TEXTILE COURSE

Columbia University, Extension Division, has announced that a new evening course in new synthetic textile fibers, yarns and materials will be given by Herbert R. Mauersberger, textile consultant, technical editor of Rayon Textile Monthly and co-author of the Rayon and Staple Fiber Handbook, American Wool Handbook and the American Cotton Handbook.

This course will include all new man made fibers, yarns and fabrics, other than rayon, namely: nylon, Vinyon, Aralac, Velon, Saran, glass, soybean fiber, peanut fiber and plastic-coated yarns. Their classification, physical, chemical and microscopical properties and characteristics will be explained fully on basis of samples, films and exhibits.

This 15 lecture course is the only one given in New York City and begins on October first, 1945, at 7 P.M. in Room 214, Hamilton Hall, 116th Street and Amsterdam Ave., New York City.

A complete folder on all evening textile courses at Columbia University is available.

● FABRIC FROM FEATHERS

Scientists in the research laboratories of the United States Rubber Company have developed a new fabric made principally from chicken feathers which is designed for use in suits, dresses, sweaters and other wearing apparel of the future.

"The new fabric looks like wool and it is warmer, softer, and lighter than wool," said Dr. W. A. Gibbons, research director of the company. "It can be dyed any color and possesses a brilliant luster. It is odorless and can be laundered in soap and water with no more shrinking than cotton. The feathers are particularly adaptable for admixture with other staple textiles, such as rayon, cotton, wool and nylon. The feather content of fabric used in the laboratory experiments ranges from 60 to 70 per cent."

Dr. Gibbons emphasized that the material is still in the laboratories and will not be put into production until it has been perfected.

Research work on feathers was started by B. H. Foster, manager of the textile section of the company's general laboratories, who was impressed by the fact that there are 100 million pounds of chicken feathers and 30 million pounds of turkey feathers going to waste in the United States every year.

He foresaw an opportunity to provide poultry raisers with an additional source of income through the sale of feathers, and at the same time to introduce a new type of clothing for men, women and children.

In the production of the yarn, the first operation is the separation of the fine elements of the feathers from the quills by a machine especially designed for this purpose. The quills are discarded and the fine elements, called barbs, are mixed with other fibers spun into yarn by a special process. The yarn is then woven into cloth in the same way that wool or any other textile is woven.

Three quarters of the feathers on a fowl can be used and 80 per cent of each feather is suitable for making yarn. Ten chickens of broiling size will yield a pound of feathers. To make an average size man's suit, the feathers of 38 broilers would be required. Thirty broilers would make a lady's suit, size 18.

Feathers from ducks, geese, turkeys and other fowl can be utilized in the same way as chicken feathers.

The quality of feathers varies, depending on the breed, age and condition of the fowl. Dr. Gibbons said the United States Rubber Company is working with the United States Department of Agriculture to set up a system for grading feathers.

• CHEMICAL CONTROLS RELAXED

The Chemicals Bureau of the War Production Board has relaxed controls to free material already allocated or obtained by certification for specific military or essential uses and which are no longer required.

This action results from the issuance of Direction 3 to the general chemicals allocation order M-300, and an amendment to Order M-340, the miscellaneous chemicals order.

Controls have been lifted from those materials controlled by M-340 where the materials have been acquired for military purposes canceled since the acquisition of the material.

In cases where material allocated by WPB under M-300 would otherwise lie idle because the consumer has canceled or has failed to place an order for this material, restrictions on the use of the material have been lifted, and the material will be available to the supplier as though it were released under paragraph (f) of Order M-300.

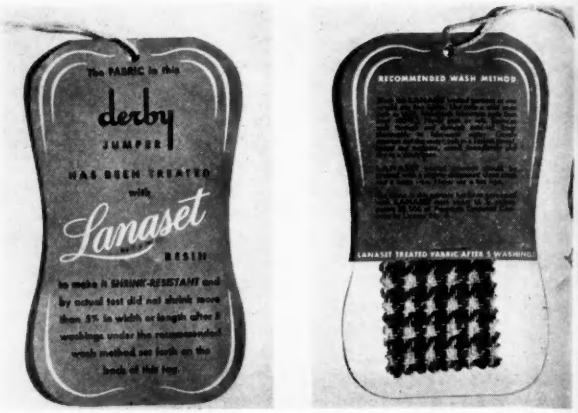
WPB explained that this section is intended to make these materials available for reconversion.

• NEW SONNEBORN BULLETIN

The Textile Chemicals Division of L. Sonneborn Sons, Inc., New York, in a new 2-page technical bulletin, tells how Syzon, an improved, mill-tested solvent sizing material, serves to facilitate and helps to simplify the sizing operation in the spinning and knitting of Nylon yarn used in the manufacture of full-fashioned and circular knit hosiery.

The bulletin, of particular interest to manufacturers of Nylon hosiery in connection with reconversion and postwar production, reports that Syzon produces a tough, yet resilient film which remains insensitive to changes in humidity and temperature. The use of Syzon, it is stated, removes the necessity of wetting on the full-fashioned knitting machines. It is said to produce a clear, uniform stitch, remain snag-resistant throughout the processing operations, and scour out easily in the boil-off and dyeing.

Copies of the bulletin may be obtained by writing on your business stationery to the Textile Chemicals Division, L. Sonneborn Sons, Inc., 88 Lexington Avenue, New York 16, New York.



The label which will be attached to every wool article treated with American Cyanamid's Lanaset resin to make wool shrink resistant.

• LANASET LABEL

All wool garments that have been treated with American Cyanamid's new Lanaset resin to make them shrink resistant will bear a unique label in the form of a tag. Carrying the manufacturer's product name the tag will also have fastened to it a certified sample of the same Lanaset-processed wool cloth as in the garment—a sample that has been washed five times.

Included in the label will be American Cyanamid's guarantee that the fabric will shrink less than five per cent when washed by hand according to the recommended method. Actual tests, however, have shown that Lanaset tends to restrict shrinkage to an average of from one to three per cent.

While the guarantee (which continues for the life of the garment) specifies hand washing, it is understood that very good results have been observed after repeated launderings in home washing machine equipment.

Careful tests of all Lanaset-processed fabric are made before the right to attach the Lanaset swatch-label is granted. However, application of Lanaset is a reasonably simple process.

• JOINS QUAKER CHEMICAL

Dr. Helmuth L. Pfluger has been appointed Director of Textile Research by Quaker Chemical Products Corporation, Conshohocken, Pa., manufacturers of chemical specialties for the textile and metal industries. He has already assumed his new post in which he will directly supervise new textile product development and service work in the Quaker Laboratories.

Dr. Pfluger received his A.B., M.A. and Ph.D. degrees from Columbia University, where he taught qualitative analysis and inorganic chemistry for a number of years. He also spent a year in post-doctorate research in Copenhagen, Denmark, during which time his academic researches were concerned chiefly with the relations between the chemical structure of organic compounds and their physical behavior.

For nearly six years, Dr. Pfluger was a member of the research staff of the Kendall Company, Walpole, Mass. In 1942 he transferred to Ludlow Manufacturing Associates, of Ludlow, Mass., where he served as Research Physical Chemist until resigning to accept his new position at Quaker.

Helmuth L. Pfluger

Dr. Pfluger is a Fellow of the American Institute of Chemists, and a member of the American Chemical Society, the American Association for the Advancement of Science, the American Association of Textile Chemists and Colorists, and the honorary societies of Phi Beta Kapa, Sigma Xi and Phi Lambda Upsilon. In his industrial work, he has been particularly concerned with the application of resins to fabrics, emulsion technology, chemical modification of fibers to obtain a variety of effects such as softening or stiffening, cellulose finishes, photomicrography and polymerization.

The appointment of Dr. Pfluger as Director of Textile Research parallels the recent appointment of Mr. Walter Haring as Director of Metal Research by Quaker, in conformity with the company's program for more intensive specialized work in both fields of research.